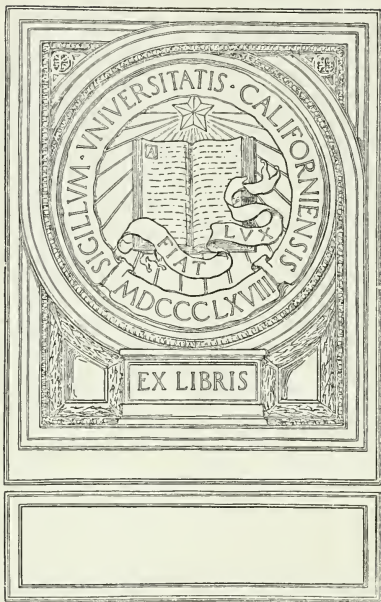


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REPORT

OF THE

BOARD FOR EXAMINATION

OF

BREECH-LOADING MILITARY SMALL ARMS.

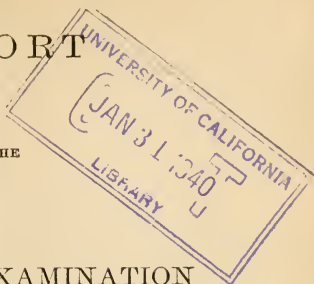
STATE OF NEW YORK.

ALBANY:
WEED, PARSONS & COMPANY, PRINTERS.
1867.

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REPORT

NEW YORK STATE ARSENAL, }
NEW YORK CITY, April 6, 1867. }

To Brigadier-General S. E. MARVIN,
Adjutant-General, Albany, N. Y.:

The Board of Officers, convened under Special Order No. 2, dated January 10, 1867, make the following

R E P O R T,

in accordance with the following orders :

GENERAL HEAD-QUARTERS, STATE OF NEW YORK, }
ADJUTANT-GENERAL'S OFFICE, }
ALBANY, *October* 10, 1866. }

Special Orders, }
No. 322. }

The following named officers are hereby appointed a commission to make examination and trial of the recent inventions and improvements in breech-loading military small arms, and especially of such inventions and improvements as have been made for alterations of the muzzle-loading military arms now in use, viz.:

Brigadier-General William Irvine, Adjutant-General.

Brigadier-General George W. Palmer, Commissary-General of Ordnance.

Colonel William G. Ward, Twelfth Regiment National Guard.

Colonel George M. Baker, Seventy-fourth Regiment National Guard.

Colonel Silas W. Burt, Assistant Inspector-General.

The said Board will convene at such time and place, and as often as circumstances may require, and make such tests and experiments as shall be calculated to prove the superiority of the different inventions and improvements which shall be offered for examination and trial, and make report thereof with all convenient dispatch.

By order of the Commander-in-Chief,

WILLIAM IRVINE, *Adjutant-General*.

GENERAL HEAD-QUARTERS, STATE OF NEW YORK, }
 ADJUTANT-GENERAL'S OFFICE, }
 ALBANY, *November 29, 1866.* }

Special Orders, }
 No. 361. }

The Board of Officers, organized by Special Order No. 322, current series, to examine and test the inventions and improvements in breech-loading military small arms, of which Brigadier-General William Irvine, Adjutant-General, is president, is hereby ordered to convene at the State Arsenal, corner of Thirty-fifth street and Seventh avenue, in the City of New York, on the 18th day of December next, 1866.

By order of the Commander-in-chief,

JNO. B. STONEHOUSE, *Assistant Adjutant-General*.

The officers therein named assembled at the State Arsenal at New York City on the 18th day of December, 1866, and continued their sessions on the 19th, 20th, 21st, 22d and 24th days of the same month, all the members being present. A number of arms were presented and subjected to a few tests, and on the 24th day of December the Board, in reporting progress to the Commander-in-Chief, submitted the following recommendation :

“ In conclusion, the Board would respectfully represent that as there are many improvements being made in breech-loading arms, which may present new and desirable features, and as the Board feel no hesitation in saying that they have not had

such full time and opportunity to make such examination in the premises as would be desirable, it respectfully recommends that further tests and examinations be ordered."

Appreciating the representations made by the Board, the Commander-in-Chief caused the following order to be made:—

GENERAL HEAD-QUARTERS, STATE OF NEW YORK, }
 ADJUTANT-GENERAL'S OFFICE, }
 ALBANY, *January 10, 1867.* }

Special Orders, }
 No. 2. }

The Board appointed by Special Order No. 322, for the "examination and trial of the recent improvements and inventions in the breech-loading military small arms, and especially of such inventions and improvements as have been made for alterations of the muzzle-loading military arms now in use," will re-convene at the State Arsenal on the 22d inst., at 10 A. M., to continue the examination of such arms as may be brought before it.

The following officers comprise the Board :

Brigadier-General George W. Palmer, Commissary-General of Ordnance.

Brigadier-General William G. Ward, commanding First Brigade, National Guard.

Colonel George M. Baker, commanding Seventy-fourth Regiment, National Guard.

Colonel Silas W. Burt, Assistant Inspector-General.

Brigadier-General William Irvine retiring on account of the expiration of his term of office.

The Board will meet from time to time, as circumstances may require, and after their examination shall have been concluded, make a full report of their investigations, with such recommendations as they may deem proper, to these headquarters.

By order of the Commander-in-Chief,

S. E. MARVIN, *Adjutant-General.*

In pursuance whereof, the officers therein named assembled on the date and at the place ordered, having previously given, by publication of the order in the leading journals of New York city, such notice as would secure a full representation of the most approved breech-loading arms yet devised. The Board held sessions on the 22d, 23d, 24th, 25th, 26th, 28th, 29th, and 30th days of January, the 19th, 20th, 21st, 22d, 23d, 25th, 26th, 27th, and 28th days of February, the 4th, 5th, 6th, 12th, 29th, and 30th days of March, and the 6th day of April.

It being ascertained that all the arms entered at the December session would be again presented, subject to such renewed and additional trials as might be established, it was, in view of the unsatisfactory results of the December trials, owing to want of time and preparation, deemed best to disregard those results, and commence *de novo*.

In establishing a programme of examination, after extended consideration, it was concluded to confine the tests to such as would have a practical relation to the results in actual service. Nor was it deemed necessary to consider, the conditions of twist and form of groove, or trajectory and accuracy at long range, all of which affect or are affected by the barrel simply. Neither was any limit fixed as to weight of arm, length and calibre of barrel, character of lock or ammunition, but these several points were noted in each arm and their merits and demerits taken into consideration. It therefore remained to subject the breech mechanism and appendages to such tests and examinations as would fully develop the qualities of those parts, and the following programme was adopted for all arms, converted and original single loading guns, as well as magazine arms :

1ST TEST. Strength of breech mechanism, or resistance to recoil and continued service—to be tested by firing rapidly one hundred rounds—with at least sixty grains of government powder (standard strength) and four hundred and fifty grains of lead for muskets and rifles, and forty-five grains of powder and three hundred and fifty grains of lead for carbines—ninety-nine rounds with one ball and the one hundredth round with two balls; the gun to be fired from a fixed rest. The time expended in firing the ninety-nine rounds will be recorded.

2D TEST. Penetration,—to be tested by firing one cartridge of sixty grains of powder (standard government strength) and four hundred and fifty grains of lead, into a target of pine boards, one inch in thickness and placed one inch apart; at a range of one hundred feet. When there is used a larger charge or different quality of powder, or greater weight of ball, or hardened by alloy of other metals than lead, these matters will be taken into consideration.

3D TEST. Rapidity of fire from the shoulder at a target, with range of one hundred feet. Each arm to be fired by some person designated by the Board. The accuracy of fire will be considered in this test. In addition, each exhibitor will be allowed to select a person to fire his arm for rapidity.

4TH TEST. Simplicity of mechanism and liabilities to derangement in ordinary service.

5TH TEST. Liabilities to derangement by accidents common to the service or by defects in the ammunition.

6TH TEST. Security against premature discharge or loss of cartridge from the loaded arm in service.

7TH TEST. Least obstruction to execution of the manual of arms, arising from peculiar mechanism of the breech-piece and appendages.

8TH TEST. Effects of moisture upon the action of the breech-piece. The arms will be subjected to the alternate action of moisture and exposure to the air, under the exclusive direction of the Board and for such time as they may consider satisfactory.

9TH TEST. Effects of the introduction of extraneous matter (sand etc.,) into the open breech.

10TH TEST. The different arms shall be exhibited by a distribution of the several parts and reassembling them, the time of each operation being noted, at the same time the functions of the several parts will be explained by the exhibitor.

Some explanatory remarks in regard to these several tests are necessary to a full comprehension of the record of the several arms, and will materially abridge that record by obviating repetition :

1st. In testing the resistance of the breech-piece to recoil, the system of many charges of ordinary size, fired continuously and rapidly, was deemed preferable to largely increased charges of powder and lead, as being more in accordance with the trial of

actual service. It is one of the valuable peculiarities of the breech-loading system that no more than one charge can be contained in the gun, and until that is discharged it is impossible to insert another. In service, the arm will have to sustain simply the test of service charges frequently fired—the ultimate resistance being a single charge expelled through a foul barrel. Seldom, if ever, will the discharges in actual service reach one hundred without opportunity of cleaning the barrel. But to simulate the action of further discharges a second ball was superadded on the one hundredth round. By firing the hundred rounds as rapidly as possible, the effects of a heated barrel were also obtained, while rapidity of movement detected any special disadvantages in the operation of the breech machinery. Imperfect lubrication in the cartridges subjected the Lamson and Hubbell guns to extraordinary tests, as will be noticed by the record, and induced the Board to investigate more carefully the matter of ammunition as a most important element in the proposition to be solved.

2d. Penetration depending as much, if not more, on the ammunition than the gun, the relative results are unimportant, as different kinds of cartridges were used, but the general result is satisfactory; and, indeed, there is no reason why a breech-loader with metallic cartridge case should not equal in penetration a muzzle-loader with same barrel, both being loaded with similar charges. This test was principally valuable in ascertaining quality of the ammunition used by each exhibitor.

3d. In firing for rapidity it was deemed proper to make accuracy so much of an element as would induce an aim over the sights. Rapidity without aim has no practical value. Each arm was fired for this test at the public sessions by some person designated by the inventor, the target being $15\frac{1}{4}$ inches in diameter. But to place all upon the same level, at the private sessions of the Board the arms were fired by privates from the National Guard, who had never handled a breech-loader before, and were given before firing five minutes to examine and work the gun, after having the mechanism explained by a member of the Board.

The 4th, 7th and 10th points of the programme were also examined at the private sessions, and any defective or objectionable parts noted.

The 5th point had in view the stability of the arm as a whole to resist the rough usage of active service, the possibility of exploding cartridges in the magazine of a repeating arm, and also the stability of the piece and the immunity of the person firing if the cartridge case should burst at the head or split in the cylindrical part. To test the result of such defects in the ammunition, each gun was fired with the proper cartridges filed on the rim of the head, so as to burst with the explosion; other cartridges were filed or cut longitudinally, so as to split when fired. These tests were deemed very important by the Board; for while improved machinery has produced a more perfect cartridge, it is not only possible, but probable, that, in the manufacture of large quantities, imperfect cases will not be detected, no matter how carefully the metal may be inspected. In the rim-fire cartridge there is also danger of an excess of fulminate.

In the determination of the 8th point, the effects of moisture, the arms were carefully cleaned and the working parts thoroughly washed with a strong solution of caustic soda to remove every trace of grease; they were then placed side by side on a rack and occasionally moistened with snow water, being allowed to dry in the intervals, this being continued for thirty-six hours, after which common salt was dissolved in the water used, and the operation continued for twenty-four hours. The arms were then thoroughly dried before being tested. This experiment may be considered severe as compared with any probable exposure to moisture in service without protection by grease or opportunity to clean the arm. But the pieces being new and clean, and many of the parts polished and case-hardened, it was only by an exposure so thorough that all the possible contingencies of future service could be reached. When in this test it was found that rust impaired the action of any portion of the gun, it was in every case attempted to overcome it by simply working the parts, and if this failed, oil was applied and worked in until the rust was softened.

The 9th Test was intended to stimulate the conditions possible in the explosion of shells casting showers of sand and earth over troops, or of riflemen in pits or trenches, in all of which contingencies sand and dirt might fall into the open breech and possibly disable the arm. In the test, the breech of each gun, immediately after firing, and consequently fouled and greasy, was opened and a handful of fine dry white sand thrown into the breech and connected machinery. The exhibitor was then allowed to remove the sand without the use of instruments, by percussion and wiping off the parts with the fingers, the piece was then loaded, if possible, and discharged, and the ejection of the case noted.

In further explanation of the descriptions of arms and record of tests it may be noted that the "length of barrel" denotes the distance from the muzzle to the face of breech-block when breech is closed. The weight of arms is given in pounds and ounces avoirdupois.

In the description is noted that the arm as presented was adapted to rim or center-fire cartridges as the case might be.

It may be remarked that any of the guns examined could be adapted to either system of cartridge.

The term "recoil seat" has been applied to the abutment forming the back of receiver as being more exact than the terms "breech" or "breech-pin."

In the 10th test, the taking apart the several separate pieces of the breech mechanism and appendages has been termed "distributing" in contradistinction to "assembling" or re-adjusting and securing the parts into the complete arm.

The letters in brackets refer to the table of cartridges on page 56.

ARMS

ADAPTED TO CONVERSION OF MUZZLE-LOADERS.

I.—THE ALLIN GUN.

Entered by A. H. ALMY, Norwich, Conn.

DESCRIPTION.

Alteration or conversion of the U. S. Springfield Rifled Musket. Length of barrel, $36\frac{1}{2}$ inches. Calibre, .50. Arranged for central-fire cartridges. Weight of entire arm, 9lbs. 15oz.

The original barrel of .58 calibre is re-enforced by the introduction of a tube of iron of such size after proper turning, reaming, etc., as to reduce the calibre to .50 ; this tube being brazed to the original barrel. In rifling, the twist is made one revolution in 40 inches, and the chamber has a taper of .075 inch. The breech-block revolves on a hinge at its forward end, and is attached by a strap soldered and screwed to upper part of barrel. No claim is made as to form or action of breech-block, nor of the lock, nor of the positive extractor ; but peculiar advantage is claimed for the locking device of the breech-block attached to it, and by means of a bolt, which enters the recoil face firmly fastening the breech when closed, and more specially is advantage claimed for the re-enforcement and reduction of the calibre of the barrel, by which greater accuracy, penetration and range are secured.

TESTS.

1ST TEST.—Ninety-nine 70-grain cartridges [H] fired in 6 minutes and 10 seconds, during which time three additional cartridges missed fire. Two balls [480 grains each] were then fired with 70 grains powder. The gun operated well, the ejector throwing out the empty cases with considerable and excessive force; in firing in two ranks the rear rank would be discomposed by a shower of cases. This objection could be obviated by reducing the elastic force of the ejector.

2D TEST.—With 70 grains powder and 480 grains lead [cartridge H] penetrated the fifteenth board.

3D TEST.—Fired for exhibitor nine shots in one minute, of which seven struck the target. Fired by private soldier seven times in one minute.

4TH TEST.—Simplicity and stability of mechanism approved.

5TH TEST.—Fired with a cartridge [H] filed thin on the head, three-quarters around; the cartridge head well bursted; breech-block firm; the gas escaping through the orifice in the barrel, through which the ejector-spring works, split the stock immediately beneath the orifice, driving off two pieces. This difficulty could be removed by using proposed improved ejector. Another similar cartridge filed in same manner was then fired, the breech remaining unaffected and no derangement of machinery. A similar cartridge cut so as to split longitudinally was fired without affecting the gun.

6TH TEST.—This piece can be fired only when the breech is fully closed, and the peculiar lock of the breech-piece prevents loss of cartridge.

7TH TEST.—No more than muzzle-loader.

8TH TEST.—Breech opened and closed readily. Three cartridges [H] fired with satisfactory result.

9TH TEST.—Sand easily dislodged by percussion and cleansing with the fingers.

10TH TEST.—Distributed in four minutes and assembled in five minutes and thirty seconds.

II.—THE ARONSON GUN.

Entered by J. H. ARONSON, No. 225 Fifth Avenue,
New York City.

Some tests were applied to this gun at the December

session, when it was withdrawn for improvements and changes. It was entered again February 19th and again withdrawn for proposed changes, and not returned in time for trial.

TESTS.

No tests.

III.—THE BERDAN BREECH-LOADING RIFLE.

Entered by HIRAM BERDAN, New York City.

DESCRIPTION.

Presented as a conversion of the Springfield and Enfield muzzle-loading Rifles, and also for manufacture of new arms. Two arms presented: 1st—Converted Springfield Rifle; length of barrel, 37 inches; calibre, .58; arranged for central-fire cartridges; weight of entire arm, 9lbs. 14oz. 2d—Converted Enfield rifle; length of barrel, $37\frac{1}{2}$ inches; calibre, .577; arranged for central-fire cartridges; weight of entire arm, 9lbs. 4oz.

Breech-block of one solid piece of metal, falling into the breech-receiver, which is formed by cutting away upper part of barrel immediately in front of breech-pin. The block revolves in a vertical plane, and is hinged on its forward end to a strap, which is attached to the top of barrel, but not permanently, having a sliding motion in line of bore of .04 of an inch. The recoil shoulder being perpendicular to line of bore, the motion of the strap admits the closing of the breech, and locks it without any additional device. The breech-block and strap can be instantly detached from the barrel, exposing to inspection the entire mechanism. The cartridge case is withdrawn by positive motion, by a projection on one of the knuckles of the hinge, and is flipped by the agency of a disc, like a cam, working on the hinge pin, to which, at a certain point, sudden

and strong motion is given by a spring, located under the strap. Same lock retained as in original piece. A lip on the breech block, projecting under the hammer when closed, effectually prevents premature explosion. The firing-pin passes through the breech-block. In addition, peculiar advantages are claimed for the cartridges used with this gun.

TESTS.

1ST TEST.—Ninety-nine 70-grain cartridges [B], fired by Mr. George Wilson, in six minutes and twenty seconds, during which time eight additional cartridges missed fire, the primers being fresh and not perfectly dried. Two balls of 460 grains each were then fired with 70 grains of powder. The breech-strap was then detached from the barrel, and the breech-block put in place, without attachment to the gun, and a 70-grain cartridge [B] fired, the breech-block not being moved by the explosion.

One hundred rounds of 100-grain cartridges [A] were fired in five minutes and thirty-five seconds, by Colonel Berdan, both hands being used to load and fire.

2D TEST.—On first trial cartridge [B], the ball penetrated the ninth board; on second trial, passed through the eleventh board.

3D TEST.—Seven shots fired in one minute by Mr. Wilson, all of which entered the target. By a private soldier, seven shots were fired in one minute.

4TH TEST.—Simplicity and stability of mechanism approved.

5TH TEST.—Fired an altered Enfield with 100-grain cartridge [A] filed half round the head, the breech-block not being attached; it was blown out. On second trial, the breech-block being attached, the block was torn from the barrel and blown off, and the hammer broken. It subsequently appearing that the above piece was made upon an old model, and its sustention of above test not claimed, the exhibitor was allowed to substitute an altered Springfield, the breech-block differing from the former, by entering the chamber of the barrel one-eighth of an inch. This gun, the breech-block being attached, was fired with a 70-grain cartridge [B] filed half way round, the breech-block remaining undisturbed by the discharge. Two more trials of same character were made, with satisfactory results. Fired with a 100-grain cartridge [A],

split longitudinally, without affecting the breech or ejecting mechanism.

6TH TEST.—This gun can be fired only when the breech is closed. A strong lip is attached to the breech-block, and in case the breech is open slightly, the hammer strikes this lip and closes the breech, or if open wider, the hammer, striking the lip, is arrested, and fails to reach the firing pin. The lock of the breech, as far as loss of cartridge is concerned, is secured by the hammer when down. When the latter is cocked, the breech is kept closed. When the gun is held with the breech downward, by the friction of the surfaces simply. To prove that the locking of the breech does not depend on the hammer, the gun was fired with 70-grain cartridges several times, without dropping the hammer, the cartridge being exploded by a long firing pin, driven in by a forcible blow.

7TH TEST.—No more than muzzle-loader.

8TH TEST.—Breech opened and closed easily. Six 100-grain cartridges [A] were fired, the cases being drawn by the retractor, but not ejected, the rust having impaired the action of the ejector spring. Such a result would not be apt to occur from any moist exposure in ordinary service.

9TH TEST.—Sand removed readily by percussion and cleansing with the finger.

10TH TEST.—Distributed in eighteen seconds, and assembled in forty-two seconds.

IV.—THE CHABOT BREECH-LOADING MUSKET.

Entered by FITCH, VAN VECHTEN & Co.,
New York City.

DESCRIPTION.

An altered Springfield musket. The breech-receiver is made by cutting away more than half the barrel from the top downward and directly in front of breech-pin. The breech-block swings on trunnions attached to a strap fastened on top of the barrel, the revolution being in a vertical plane and toward the muzzle. The breech is locked when closed, the block being operated by a projecting handle opposite the hammer. The

retractor is operated by the movement of the breech-block and the case is flipped by a spring placed beneath the barrel.

TESTS.

The exhibitor being absent, no tests were applied to this arm after the December session.

V.—THE COCHRAN GUN.

Model exhibited. Not prepared for trial.

VI.—THE EMPIRE BREECH-LOADING RIFLE, NO. 1.

Entered by GEORGE B. WALTER, No. 64 Broadway,
New York City.

DESCRIPTION.

An original arm, though adapted to conversion of muzzle-loaders. Length of barrel 33 inches. Calibre, .50. Arranged for rim-fire cartridges. Weight of entire arm, 9 lbs. 12 ozs. Breech-block of one solid piece of metal semi-circular in form, hinged to the barrel on left hand side and operating at right angles to the barrel, and dropping into a receiver between the cartridge chamber and recoil shoulder, and locked in position by a spring bolt operated by knob on right hand side of the block. The retractor, retracting bar at right angles to bore of barrel, and retractor lever and spring are located in the under part of breech-receiver and operated by the movement of the breech-block. In alteration of muzzle-loaders, the barrel would be cut off and a new breech-receiver screwed on. The lock is peculiar.

TESTS.

1ST TEST.—Fired with 45-grain cartridges [N] ninety-nine times in six minutes and forty-five seconds. During the firing a difficulty in fully opening the breech, and so extracting cartridge case, was noticed; otherwise the trial was satisfactory. Then fired with 45 grains of powder and two balls of 335 grains each, without any derangement.

2D TEST.—With 60 grains powder and 350 grains lead penetrated the eleventh board.

3D TEST.—Fired on behalf of exhibitor by Mr. Smith, times in a minute.

4TH TEST.—Mechanism simple and strong.

5TH TEST.—Fired with a 45-grain cartridge [N] filed half way round without effect on the breech. With a 60-grain cartridge [L] with the same result, though chamber and breech machinery were much fouled. A 70-grain cartridge [I] filed half way round, the head bursting well, raised the breech-block and hammer about one-tenth of an inch and the retractor cap was moved out about same distance. Fired with a 60-grain cartridge split longitudinally without affecting the breech.

6TH TEST.—This gun can be fired only when breech is closed, and the lock bolt on breech-block prevents loss of ammunition.

7TH TEST.—Equal to Springfield muzzle-loading rifle.

8TH TEST.—Rusted so that retractor would not play in its groove and resisted the closing of the breech-cap. Could not be moved until after being well oiled, when the retractor was loosened and the cap closed. The gun was then fired twice with 45-grain cartridges [N] the machinery working well.

9TH TEST.—Sand removed by percussion and brushing out with the fingers, the breech was then readily closed, but the retractor worked with difficulty—this piece plays in a groove, which retains the sand. After working the retractor to and fro for a short time, the sand in groove was mostly dislodged.

10TH TEST.—Dismounted in two minutes and five seconds, and assembled in four minutes.

VII.—THE EMPIRE BREECH-LOADING RIFLE, NO. 2.

Entered by GEORGE B. WALTER, No. 64 Broadway,
New York City.

DESCRIPTION.

A Converted Springfield rifle. Length of barrel, 39 inches. Calibre, .58. Arranged for rim-fire cartridges. Weight of entire arm, 9lbs. 4oz. The barrel of the muzzle-loader is cut through immediately in front of breech-pin and swings on a hinge $32\frac{3}{8}$ inches from the muzzle and $6\frac{5}{8}$ inches from the breech, the stock being

divided at same point to allow motion. The barrel drops down at the muzzle, the breech rising about two inches to insert the cartridge, the limit of motion being controlled by a bridle attached to the breech and the stock. The stock underneath the breech is re-enforced by a plate of iron inserted in it. The breech is locked by a bolt passing from the breech-pin under the barrel and operated by a spring. The original barrel, stock and lock are retained, and the gun presents about the same appearance as before the alteration. The motion of cocking the piece opens the breech and retracts the cartridge-case.

TESTS.

1ST TEST.—Fired with two 60-grain cartridges [D] ninety-nine times in four minutes and forty seconds; then fired with 60 grains powder and two balls of 480 grains each. The gun withstood this test well.

2D TEST.—With cartridge [D] of 60 grains powder and 480 grains lead penetrated into the twelfth board.

3D TEST.—Fired for exhibitor by Mr. Isaac Smith eighteen shots in one minute, four of which were in the target. Fired by private soldier six times in one minute.

4TH TEST.—The breech mechanism very simple, but the connection of the barrel to the stock at $6\frac{3}{8}$ inches from the breech by a single pin of comparatively small diameter, and the division of the stock at that point, are deemed elements of weakness.

5TH TEST.—Fired with a 60-grain cartridge [D] filed thin on one side, failed to derange the breech, but slightly bent the extractor. On second trial with similar cartridge the stock immediately in front of guard was split into several pieces. Permission having been granted, the gun was withdrawn for repairs, and another and superior stock put in and again presented. Fired twice with 60-grain cartridges filed half round, without affecting the gun. Upon third trial with similar cartridge the stock split in same manner as on former trial, several pieces being driven off, but the gun otherwise unimpaired. Fired with a 60-grain cartridge split longitudinally without affecting the gun.

6TH TEST.—No danger of exploding the cartridge before the breech is closed, nor of loss of ammunition.

7TH TEST.—Equal in this respect to muzzle-loader.

8TH TEST.—Rusted so that extractor and breech-lock would not operate. Upon application of oil the rusted parts were loosened, and three 60-grain cartridges fired, the parts working well.

9TH TEST.—Sand was easily dislodged by percussion.

10TH TEST.—Distributed in thirty seconds and assembled in forty-five seconds.

VIII.—THE FITCH & POWERS GUN.

Entered by FITCH, VAN VECHTEN & Co., Fifty-second street, New York City.

DESCRIPTION.

This gun was exhibited in reference simply to the retractor, which, for example, was attached to an Allin Gun [I]. As the patent had not been secured, the description is omitted; but it may be stated that the Board considered the improvement well worthy of consideration, though being merely an element in a practical breech-loader, it could not enter into full competition with arms presented as complete combinations. To exhibit the action of the retractor the gun was submitted to a few tests and then withdrawn.

TESTS.

1ST TEST.—Ninety-nine rounds of 60-grain cartridges were fired in eight minutes and fifty-two seconds. Then fired with 60 grains powder and 960 grains of lead. The retractor worked well during this test, drawing and expelling the empty cases without failure.

2D TEST.—With 60 grains of powder and 480 grains of lead penetrated the twelfth board.

3D TEST.—Fired by the exhibitor, Mr. J. P. Fitch, twelve times in one minute, two balls in the target.

9TH TEST.—The action of the breech-piece was somewhat disabled at first, but being finally freed from sand by percussion and wiping, it worked more satisfactorily.

This gun having been entered simply as an improvement on the Allin Gun [I] as far as retractor is concerned, it was not submitted, to further test.

IX.—GRAY'S BREECH-LOADING RIFLE.

Entered by JOSHUA GRAY, Boston, Mass.

DESCRIPTION.

For conversion of muzzle-loading arms and also as an original arm. Length of barrel $38\frac{1}{2}$ inches. Calibre .50. Adapted to rim-fire cartridges. Weight of entire arm, 9 lbs. 14 ozs.

The gun presented was a converted Springfield. The barrel of the original gun is cut off just in front of the breech-pin and screwed into a breech-receiver, in which works the breech-block, composed of two parts, the breech pin which closes the breech and receives the direct recoil, transmitting it through the breech lever to the recoil seat which is perpendicular to the axis of the barrel. A handle to the lever extends back over the stock, which being raised lifts the recoil shoulder above the receiver (the breech-pin and lever being hinged together), the lever is then drawn directly back, bringing the breech-pin to the rear of receiver, the cartridge is then dropped into the space in the receiver vacated by the pin, and the motions above described being reversed, the cartridge is inserted in the chamber and the breech closed. The retractor plays in a recess in the bottom of the receiver with a positive motion—the motion of the lever in operating the breech-pin. The cartridge flipper is placed beneath the barrel. There is only one spring that locks the breech.

TESTS.

1ST TEST. Fired ninety-nine 60-grain cartridges [F] in eight minutes. Then fired with 60 grains powder and 960 grains lead. All parts of the mechanism worked well during and after this trial.

2D TEST.—With 60-grain cartridge [F] penetrated the twelfth board.

3D TEST.—Eight rounds were fired by the exhibitor (Mr. Gray) in fifty-five seconds, seven balls entering the target. Private soldier fired six rounds in one minute.

4TH TEST.—The breech-block strong and simple, the knob for working is however small and difficult to manipulate. The retractor is strong and positive in motion, operated by the breech-lever.

5TH TEST.—Fired with a 60-grain cartridge [E] filed round one-half the head, which slightly raised the breech-lever. A similar cartridge on second trial raised the lever entirely above its bearing. A similar cartridge not filed on the head, but split longitudinally did not affect the arm.

6TH TEST.—Security against premature discharge is perfect, as hammer cannot strike firing pin till the breech is entirely closed, nor would cartridge be lost from the chamber by accidental opening of the breech.

7TH TEST.—Unobjectionable under this test.

8TH TEST.—Impossible to raise the breech-lever except by means of a rod placed through orifice immediately below the knob [see 4th test.] After oiling the working parts, three 60-grain cartridges [E] were fired with satisfactory result.

9TH TEST.—Sand easily dislodged by percussion and cleaning with the fingers.

10TH TEST.—Distributed in thirty seconds and assembled in fifty-five seconds.

X.—HUBBELL'S BREECH-LOADING RIFLE.

Entered by JAMES H. ORNE, Philadelphia, Pa.

DESCRIPTION.

For conversion of muzzle-loading arms or as original arm.

The gun presented was an altered Springfield rifle, Calibre .50, and adapted to central-fire cartridges. The barrel of original gun is cut off in front of the breech-pin, and screwed into a new breech-receiver. The breech-block consists of two parts, one of them is hinged to back part of receiver and opens upward, moving in a vertical plane. The other works back and

forth in grooves in the receiver and is attached to the former part by two slotted links. The first part being raised (working upon the hinges in its rear) draws back the second part which leaves sufficient space in the receiver for the cartridge which is dropped in and the hinged block being depressed, drives the front block forward, forcing the cartridge into the chamber, when the two blocks occupy the receiver and transmit the recoil in the line of axis of the barrel to the square recoil seat. The cartridge is retracted by a small steel hook attached to the front block and working in a slot in the receiver. It is flipped by suddenly opening the breech which gives a rapid movement to the case, when it strikes a projection in the bottom of receiver which tilts it and throws it out. The lock of original gun is retained, the percussion being transmitted to the cartridge by means of a firing pin composed of three parts—two parts in the back block, which change the line of motion, and the other part in the front block.

TESTS.

1ST TEST.—Fired ninety-nine 60-grain cartridges [K] in thirteen minutes and thirty-two seconds. An extra ball taken from cartridge [K] was then placed in the muzzle and driven down with a ramrod, the resistance was very great and it was only after continued effort by driving the rammer with heavy blows that the ball was rammed down. It finally dislodged from the interior of the barrel, about thirteen inches from the muzzle, a mass of mingled burnt powder and lead amounting to half a gill, which had gradually adhered to the bore. The ball finally driven through was entirely disfigured, being elongated, its greatest diameter reduced from .52 to .49, while the part that first met the obstruction and was driven into it before the mass was dislodged was reduced to an average of .38 of an inch in diameter for a length of .2 of an inch. From this it is evident that a portion of the barrel was practically reduced in calibre to .38 of an inch, through which small aperture balls of a calibre of .50 of an inch were driven by 60 grains of powder.

The strength of the breech, and especially of the barrel, were well attested by this unpremeditated result. Upon an examination of the cartridges, it was evident that the fouling was occasioned by inadequate lubrication of the cartridges, although manufactured at an United States arsenal. The gun was not submitted to the test of two balls, the test being considered unnecessary after the above-described endurance of the parts.

2D TEST.—With 60-grain cartridge [K], penetrated the twelfth board.

3D TEST.—Fired by Mr. J. M. Cooper, on behalf of exhibitor, eight times in fifty-six seconds; three balls in the target.

The gun was withdrawn before being submitted to firing by private soldier, or to the other tests.

XI.—JOSLYN'S CAP BREECH-LOADING RIFLE.

Entered by Mr. WILLIAM HERRICK, New York City.

DESCRIPTION.

As an original arm, and also for conversion of muzzle-loaders.

Length of barrel, 28 inches; calibre, .50; adapted to rim-fire cartridges; weight of entire arm, 9 lbs. 8 ozs.

For conversion of muzzle-loaders, the original barrel is cut off and screwed into a breech-receiver. The breech-block is a semi-circular cap, hinged upon the left side of receiver, and revolving at right angles to axis of barrel, and when closed, a projecting rim falls in front of the rim of receiver, where barrel is screwed in and fits closely to the barrel. The rear of the cap, when closed, rests against the recoil-seat, which, together with the projecting rim, gives a recoil support in front and rear ends of cap; a simple spring-bolt, operated by a knob on right side of receiver, secures the cap when closed.

The retractor is worked by a screw on the hinge of the cap, drawing the shell directly back. There is no

peculiarity in the lock, the firing-pin being in usual shape and remarkably strong.

TESTS.

1ST TEST.—Ninety-nine 45-grain cartridges [N] fired in seven minutes and forty-five seconds. Fired then with 45 grains powder and two balls of 355 grains each. The gun bore this test well.

2D TEST.—With 45 grains powder and 355 of lead, penetrated the eleventh board.

3D TEST.—Ten shots fired in one minute by Mr. Joslyn, of which eight struck the target. Eight shots in one minute fired by a private soldier.

4TH TEST.—Mechanism simple and retractor especially strong.

5TH TEST.—A 45-grain cartridge, filed half way round, failed to disturb the breech. Another similar cartridge fired with same result. The gun was withdrawn by exhibitor, and gas vent bored through the top of cap. It was then fired with a 60-grain cartridge [L], filed half way round, and the breech was undisturbed. The hinge pin and lock catch of the breech-cap were then removed, the cap simply resting in place unattached, and the gun was fired with a 60-grain cartridge [L] without affecting the cap. Fired with a 60-grain cartridge split longitudinally, without affecting the gun or its mechanism.

6TH TEST.—The hammer, in falling, strikes the breech-cap in such manner as to prevent premature discharge, and the lock catch secures the breech in any position of the gun.

7TH TEST.—The mechanism of the breech being compact, it offers no obstructions.

8TH TEST.—Unaffected by moisture, the working parts being well case-hardened, resisted the action of water.

9TH TEST.—Sand dislodged by percussion of the gun and cleansing with the fingers, though not without some labor.

10TH TEST.—Distributed in forty seconds, and assembled in one minute.

XII.—THE JOSLYN SWING-BREECH GUN.

Entered by Mr. WILLIAM HERRICK, New York City.

DESCRIPTION.

As an original arm and also for conversion of muzzle-loaders.

Length of barrel, $36\frac{1}{2}$ inches; calibre, .50; adapted to rim-fire cartridges; weight of entire arm, 10 lbs. 8 ozs.

For conversion of muzzle-loaders, the barrel is cut off and screwed into a breech-receiver. The breech-block is a solid piece of metal (weighing about a pound), which revolves in a horizontal plane, on a large pivot in rear of receiver, the motion being to the left in opening the breech. There is a shoulder on the lower face of the block, toward the rear, which revolves on a corresponding shoulder on the bottom of receiver, which shoulders resist the recoil, none being sustained by the point of revolution.

The breech, when closed, is locked by a spring-bolt, operated by a knob on the right-hand side. The retractor, working in the bottom of the receiver, and operated by the swinging of the breech-block, has a positive motion. No peculiarity in lock or firing-pin.

TESTS.

1ST TEST.—Ninety-nine 60-grain cartridges [L] fired in eight minutes and thirty seconds; then fired with 60 grains powder and two balls of 380 grains each without affecting the mechanism or free working of the gun.

2D TEST.—Penetrated tenth board with 60 grains powder and 380 grains of lead [L].

3D TEST.—Fired by Mr. Joslyn eight shots in one minute, all of which struck the target. Seven shots in a minute fired by private soldier.

4TH TEST.—Breech-piece being a solid piece of metal is very stable; the other mechanism is strong and simple.

5TH TEST.—Fired with a 60-grain cartridge [L] filed half way round, the breech and mechanism were unaffected, but the escape of gas between face of block and barrel would have severely burned the hand of a person firing. A second cartridge [L] filed in same manner was fired and opened the stock slightly, and jammed the breech so tightly that it required the blows of a hammer to open it. Fired with a similar cartridge split longitudinally without affecting the gun.

6TH TEST.—Secure from premature discharge or loss of cartridge when loaded.

7TH TEST.—No obstructions.

8TH TEST.—The retractor groove being much rusted the retractor could not play and breech could not be closed. After the breech had been partially closed and opened full, several times, the retractor moved and breech was closed. Three 45-grain cartridges were then fired satisfactorily.

9TH TEST.—Sand easily removed by percussion.

10TH TEST.—Distributed in two minutes and thirty-five seconds and assembled in four minutes and fifty-five seconds.

XIII.—THE LAMSON BREECH-LOADING RIFLE.

Entered by the WINDSOR MANUFACTURING COMPANY,
Windsor, Vt.

DESCRIPTION.

For conversion of muzzle-loading arms or as an original arm. Two arms entered, both converted Springfield muskets and similar in all respects, except one adapted to rim-fire and the other to central-fire cartridges. Length of barrel, 37 inches. Calibre, .58. Weight of entire arm, 9 lbs. 14 oz.

The breech-receiver is formed by cutting away the upper part of the barrel in front of the breech-pin. The breech-block is rebated longitudinally to the carrier-block, which is hinged on its front end to a strap firmly secured by means of lugs and screws to the top

of the barrel in front of the receiver. The firing-pin passes through both blocks and is retained by a small screw on top of the carrier-block, which screw also limits the sliding motion of the blocks on each other to 0.05 inch. This motion is necessary to obtain the square recoil shoulder combined with rotary motion on the hinge. The retractor is rotary, consisting of a small disk or cam working on the pin of the hinge, the cartridge case being drawn by a positive motion as the breech is opened, when at a certain point a sudden accelerated motion is given to the retractor by a flat spring on top of the strap, which motion ejects the case over-ways in back of receiver. A lip on the carrier-block projects beneath the hammer when closed, and prevents accidental explosion before breech is closed, and by aid of the hammer assists in locking the breech.

TESTS OF RIM-FIRE GUN.

1ST TEST.—Fired ninety-nine 60-grain cartridges [D] in six minutes and forty-six seconds. It was noticed that the barrel became unusually hot and the recoil gradually increasing as the firing progressed. On ramming down a ball from the muzzle great difficulty was experienced, and it was only by long-continued blows with a hammer that the ball was forced to the breech, when it brought out a large quantity of burnt powder and lead. This result, as in the Hubbell gun heretofore mentioned, was occasioned by lack of lubricant on the bullets, and as in that case United States cartridges were used. The piece was then fired with 60 grains powder and two balls of 480 grains each. The entire test was satisfactory, and the gun successfully sustained a greater strain than that proposed.

2D TEST.—With 72 grains powder and 480 grains of lead [C] the ball penetrated the eleventh board. With similar charge, on second trial, penetrated the twelfth board.

3D TEST.—Fired by C. S. Wight on behalf of exhibitor twelve times in one minute, four balls striking the target. Fired by private soldier seven times in one minute.

4TH TEST.—Mechanism simple and strong.

5TH TEST.—Fired with a 60-grain cartridge [E] filed on the head half way round, the breech-block was blown open, the lip beneath the hammer being broken off and the hinge broken, the strap attached to the barrel was also loosened.

[The gun being completely disabled by Test No. 5 was not submitted to further trials, except that Test No. 9 had been applied previously.]

9TH TEST.—Sand readily removed by ordinary means, though some difficulty was encountered in inserting cartridge.

TESTS OF CENTRE-FIRE.

1ST TEST.—There were fired 16, 16, 15, 15, 11 and 7 cartridges [60 grains] in successive minutes, with a number of misfires. After the 86th discharge the cases became fixed in the chamber and the retractor would not draw them. The remaining 13 cartridges were fired at irregular intervals, two and a half minutes being taken at one time to draw a case. It was not determined whether this resulted from any defect in the chamber or mechanism of the breech or use of unsuitable cartridges. The tests applied to the Lamson rim-fire gun, in all respects similar except in position of the firing-pin, were satisfactory as to this test.

2D TEST.—With 60 grains powder and 480 grains lead penetrated into the eleventh board.

3D TEST.—Fired on behalf of exhibitor twelve times in one minute, eleven balls entering the target. Fired by private soldier seven times in one minute.

4TH TEST.—Same as Lamson's rim-fire.

5TH TEST.—Fired with a 60-grain cartridge filed on the head half way round; the breech blown open, bending up the hinge-strap attached to barrel so that breech could not thereafter be closed.

[This gun being disabled by the last-named test was not subjected to further trials.]

XIV. — MILBANK'S SIDE-GATE BREECH-LOADER.

Entered by J. M. MILBANKS, Greenville Hill, Conn.

DESCRIPTION.

A converted Springfield rifle; also intended for original arms. Length of barrel, 36½ inches. Calibre, .58. Adapted to rim-fire cartridges. Weight of entire

arm, 9 lbs. 4 oz. The barrel cut out in front of breech-pin on top and right-hand side to receive breech-block, which is hinged to front of receiver, moving in a horizontal plane to the right in opening the breech. Locks by the hammer catching over projection on rear end of breech-block, the hammer being secured by a notched bolt let into lock-plate. Lock of original gun retained. Retractor worked by movement of breech-block, and on the principle of a cant-hook, working in a recess cut in the face of the breech-block, seizing the flange of the shell and being kept fed to its grasp by the action of a spring, draws the shell fully seven-eighths of an inch, insuring its entire release. Rapid movement secures ejection.

TESTS.

1ST TEST.—Fired ninety-nine 60-grain cartridges [E] in six minutes and fifty-five seconds; then fired with 60 grains powder and 960 grains lead; the gun not affected in any part.

2D TEST.—With 60 grains powder and 480 grains of lead [cartridge E] the ball penetrated the eleventh board.

3D TEST.—Fired by Mr. S. H. Pennoyer for exhibitor nine shots in one minute, all of which struck the target. By private soldier, eight rounds in sixty-one seconds.

4TH TEST.—Simple and stable.

5TH TEST.—Fired with a 60-grain cartridge [E] filed half way round without affecting the mechanism. Fired with similar cartridge filed three-quarters way round; breech-block blown open, but gun not otherwise affected nor mechanism deranged. Fired with similar cartridge split longitudinally without in any way disabling the piece.

6TH TEST.—Cannot be fired except when breech is closed, nor can cartridge be dropped from chamber as the breech-block is locked in position.

7TH TEST.—No more obstructions than in muzzle-loading arms.

8TH TEST.—Breech opened and closed, but with great difficulty at first, but more readily after being worked to and fro. Three 60-grain cartridges then fired with satisfactory result.

9TH TEST.—The breech readily cleansed from sand with the fingers.

10TH TEST.—This gun was not dismounted.

TESTS OF CENTRE FIRE.

Only tested for rapidity by Mr. S. H. Pennoyer for the exhibitor. Eight shots (and two misfires from imperfect cartridges) in one minute.

XV.—MEIGS' BREECH-LOADING RIFLE.

Entered by Mr. J. V. MEIGS, Lowell, Mass.

DESCRIPTION.

For conversion of muzzle-loading arms. The gun presented was a converted Springfield rifle. Length of barrel $37\frac{3}{8}$ inches. Calibre .58. Adapted to rim-fire cartridges. Weight of entire arm 9 lbs. 4 ozs.

The original barrel has a vertical mortise about two inches in length cut through it at the breech, into which a rectangular breech-block is fitted. A plate is put on the under side of the neck of the stock, taking the same curve; to this plate the old guard plate with trigger and bow is so attached that it can slide to the rear. To the front end of the guard plate an elbowed connecting piece is pivoted, which has a pin on one side at or near the elbow, working in a horizontal slot in the side of the rectangular block. Upon the other side of the connecting piece there is another pin working in a guide slot in a plate attached to the slide plate. Drawing the guard backward, this connecting piece at its pivoted end moves with it and by means of the pin on the side working in the slot assisted by the pin on the other side working in the guide slot, pulls the block down to the rest, at the same time the disengaged end of the elbow hooks over the rim of the shell in the barrel, and then slides, following the slots in the block and guide, horizontally to the rear, retracting the shell

and throwing it out of the receiver. The method of loading reverses the above operation, the cartridge being dropped into the receiver is inserted in the chamber by the retractor in its return movement. [Since the above description and the tests given below, the gun has been shown informally to members of the Board, with certain important improvements.]

TESTS.

1ST TEST.—Ninety-nine 60-grain cartridges [D] fired in five minutes and forty seconds—then fired with 60-grains powder and two balls of 480 grains each. Mechanism not in any respect affected.

2D TEST.—With 60 grains powder and 480 grains lead the ball penetrated the eleventh board.

3D TEST.—Fired by the inventor sixteen times in one minute, seven balls striking the target. Fired by private soldier eight times in one minute.

4TH TEST.—Mechanism simple and from peculiarity of the movements well adapted for rapid manipulation in firing. A large friction surface in the moving parts requiring care in manufacture to prevent undue wear.

5TH TEST.—Fired twice with 60-grain cartridges [E] filed half and three-quarters way round without in any way affecting the mechanism. Fired with similar cartridge split longitudinally without affecting the gun.

6TH TEST.—Can be fired only when breech is closed and an efficient lock of breech-piece prevents loss of cartridge from chamber.

7TH TEST.—No obstructions.

8TH TEST.—It was impossible to move the breech-block, the large sliding surfaces being rusted produced a friction which it was impossible to overcome. A liberal application of oil which was allowed to penetrate to all the working surfaces enabled the breech to be moved and after a little working to and fro, the mechanism worked freely. Three 60-grain cartridges [E] were then fired with satisfactory results.

9TH TEST.—After repeated percussion, most of the sand was removed, the mechanism being slightly obstructed by what

remained, but after some difficulty its efficiency was restored and a 60-grain cartridge exploded and case ejected.

10TH TEST.—Distributed in two minutes and forty-five seconds, and assembled in one minute and fifteen seconds.

XVI.—MONTSTORM BREECH-LOADING RIFLE.

Entered by Mr. POULTNEY, Baltimore, Md.

DESCRIPTION.

For conversion of Muzzle-loading arms. The gun presented was an altered Springfield rifle. Length of barrel $36\frac{1}{2}$ inches. Calibre .58. Adapted to rim-fire cartridges. Weight of entire arm, 9 lbs. 4 ozs.

The receiver formed by cutting away the upper part of barrel in front of breech-pin, in which the breech-block lies, being hinged on its forward end to a strap attached firmly to the barrel in front of receiver and having a motion in a vertical plane. The breech-block is locked by a bolt which enters its rear end and moved by the mechanism of the lock—*i. e.*—entering and withdrawing from the block as the hammer is dropped or raised. The retractor is positive in its action and the firing-pin in usual form and passing through the breech block. The lock of original gun is retained.

TESTS.

1ST TEST.—Fired ninety-nine 60-grain cartridges [E] in seven minutes and nine seconds. Then fired with 60 grains powder and two balls of 480 grains each. The mechanism worked well.

2D TEST.—With 60 grains powder and 480 grains lead, penetrated through ten boards.

3D TEST.—Fired by Mr. A. G. Sinclair, for exhibitor, eleven times in fifty-seven seconds, seven balls entering the target. Fired by private soldier seven times in one minute.

4TH TEST.—Mechanism stable and strong.

5TH TEST.—Fired twice with 60-grain cartridges [E], filed two-thirds round the rim, without opening the breech or affecting the

mechanism. Fired with similar cartridge split longitudinally, with same result.

6TH TEST.—Can only be fired when breech is closed, and breech-lock secures the cartridge.

7TH TEST.—No obstructions.

8TH TEST.—Breech opened and closed with difficulty, the lock-bolt of breech moving stiffly from rust. Three 60-grain cartridges fired with satisfactory result.

9TH TEST.—Not affected by sand, which is readily dislodged by ordinary means.

10TH TEST.—Distributed in three minutes, and assembled in three minutes and twenty seconds.

XVII.—THE ROBERTS BREECH-LOADING RIFLE.

Entered by General A. H. PLEASANTON,
President Roberts B. L. Arms Co., New York.

DESCRIPTION.

For conversion of muzzle-loading arms and as an original arm.

The gun presented was an altered Springfield rifle. Length of barrel, $37\frac{3}{4}$ inches. Calibre, .58. Adapted to rim-fire cartridges; weight of entire arm, 9 lbs. 13 ozs. For conversion, the barrel of original arm is cut off in front of breech-pin, and screwed into a receiver. In the receiver works the breech-block, which moves upon the recoil seat by means of a shoulder, the seat being semi-cylindrical and the shoulder fitting it. The breech-block extends back over the neck of the stock, forming a lever by which the block is depressed to open the breech, or raised to close it, the lever having reverse motions. To the back end of this lever is attached a finger-piece and catch, which, when the breech is closed, locks it securely. The breech-block is hollowed out, spoon-like on its top, to guide the cartridge in loading, and its face is composed of a steel plate, which presses

against the cartridge and has a slight motion on the block, being, as it were, hinged to it horizontally and on its centre. By means of a projection on the lever, which is struck by the hammer in firing, the breech is closed and locked in cocking the piece. The retractor is a simple elbow lever, worked by the breech mechanism, and having a positive action, and the cartridge is ejected by the sudden movement in opening the breech. The firing pin passes down in recess in the receiver beside the block. The recoil is transmitted in the line of the axis of the barrel to the recoil seat. The chamber is made slightly conical, and cartridges of corresponding form are used, whereby an advantage in the ease of retracting the case is secured. (See G in table of cartridges.)

TESTS.

1ST TEST.—Ninety-nine 60-grain cartridges [G] were fired in six minutes and fifty seconds. Then fired with 60 grains fine rifle powder and two balls of 670 grains each. This test entirely satisfactory, the mechanism operating well. The barrel was much heated.

2D TEST.—With 60 grains fine powder and 670 grains lead, penetrated through fifteen boards, striking iron plate behind with some force.

3D TEST.—Fired by General Pleasanton fourteen times in one minute, all the balls striking the target. Fired by private soldier eight times in sixty-two seconds.

4TH TEST.—Mechanism very simple and strong. No springs connected with the breech or retractor.

5TH TEST.—Fired twice with 60-grain cartridges [A], filed on the flange half way round, without in any way affecting the breech or other parts of the gun. Again fired twice with similar cartridges filed all around the flange except quarter of an inch for firing-pin to strike on; the result entirely satisfactory, the breech in each case remaining locked and all the mechanism in perfect working order. The residuum fouled the breech-block, so that some difficulty was encountered in moving it, but soon worked

clear, without any appliances. A similar cartridge split longitudinally was fired, without affecting any portion of the gun; the cartridge-case, however, could not be removed by the retractor, owing to imperfect counter-bore, the shell being expanded into the inequalities. This, however, is not a fault of the system, but attributable simply to defective workmanship.

6TH TEST.—Cannot be fired except when the breech is nearly closed, the small distance remaining to be closed not being in any way dangerous, as was proven in the test of the Peabody rifle (see beyond), nor can cartridge be lost from the chamber, the breech-lock being very efficient.

7TH TEST.—No obstructions.

8TH TEST.—After rusting it was impossible to open the breech by a steady pull on the lever, but a sudden jerk opened it, and this jerk had to be continued till working surfaces were freed from rust. Three 60-grain cartridges [G] were then fired, the case of the first not being retracted, the head being held by the rusted surface, but the cases of the other two retracted and thrown out.

9TH TEST.—Sand easily dislodged by concussion and cleansing with the fingers.

10TH TEST.—Distributed in four minutes and assembled in three minutes and forty-five seconds.

ARMS NOT SPECIALLY ADAPTED TO CONVERSION OF MUZZLE-LOADERS.

I.—THE BALLARD BREECH-LOADING RIFLE AND CARBINE.

Entered by MERWIN & SIMPKINS, New York City.

DESCRIPTION.

Carbine presented. Length of barrel, 22 inches. Calibre .45. Adapted to rim-fire cartridges. Weight of entire arm, 7 lbs. 8 oz.

Breech-receiver in shape of vertical mortise through a rectangular block into which barrel is screwed. The breech-block is in two parts, divided by a vertical plane, and containing the lock mechanism. The breech-block is operated by a lever underneath, by which the breech-block and lock are dropped beneath the chamber so as to insert the cartridge, the block having a horizontal movement as well as vertical. No firing-pin is used, the cartridge being exploded directly by a projection on the face of the hammer. The ejector has a positive motion parallel to the barrel, and operated independently of the breech mechanism,

TESTS.

2D TEST.—With....grains powder and.... grains lead the ball penetrated the.....board.

3D TEST.—Fired by.....on behalf of exhibitor

.... times in one minute, no target being used. Fired by private soldier seven times in fifty-seven seconds.

5TH TEST.—Fired with 45-grain cartridge [N] split longitudinally without affecting the mechanism.

6TH TEST.—Mechanism strong, the retractor not operated by breech-lever but requiring independent movement.

7TH TEST.—No objectionable obstructions.

8TH TEST.—Breech opened and closed with difficulty, and required application of oil to loosen the rust. Then fired with 45-grain cartridges thrice, the several parts operating well.

II.—THE MILLER BREECH-LOADING RIFLE.

Entered by W. H. & G. W. MILLER, West Meriden Connecticut.

DESCRIPTION.

Length of barrel, $28\frac{3}{4}$ inches. Calibre, .50. Adapted to rim-fire cartridges. Weight of entire arm, 8 lbs. 4 oz.

Barrel screwed into breech-receiver. Breech-block in the form of a segment of a cylinder, one of the plane faces resting against the head of cartridge in the chamber; from the top of this breech-face projects on either side an ear, which fits into a notch in the side of the receiver. The breech-block revolves on a pin passing through a horizontal slot in the block. The angle of the segment is rounded on a small circle and geared, two teeth extending up the vertical plane. The lever operating underneath is toothed on its short arm, working an intermediate pinion whose teeth fit into those on the breech-block. By drawing down the lever, motion is communicated to the pinion, which by means of the teeth on the vertical plane of the block raises the block so as to disengage the projecting ears from the notches in the receiver, the slot allowing just this upward movement; the teeth of the pinion then engaging those on the small circle, the block revolves to the rear, open-

ing the breech for the reception of the cartridge. A reverse movement closes the breech. Retractor positive in motion and operated by the intermediate pinion. The firing-pin works through the block in usual manner. The lock is central.

TESTS.

1ST TEST.—Fired ninety-nine 60 grain cartridges [M] in nine minutes and twenty-seven seconds. Then fired with 60 grains powder and two balls of 435 grains each—with satisfactory result, the several parts of the mechanism working well.

2D TEST.—With 60 grains powder and 435 grains lead hardened with antimony the fifteenth board was penetrated. With same charge of powder and balls of pure lead the eighth board on first trial and the ninth board on the second trial were penetrated.

3D TEST.—Fired by the inventor ten times in one minute, four balls entering the target. Fired by private soldier six times in one minute.

4TH TEST.—The breech mechanism very strongly and perfectly constructed, but complicated.

5TH TEST.—Fired with a 60-grain cartridge [L] filed on the head half way round without affecting the breech or appendages. Experiment repeated with same result. Fired with similar cartridge split longitudinally without detriment to the gun.

6TH TEST.—Peculiar construction and lock of breech-piece render the gun especially secure.

7TH TEST.—Equal to other guns with breech operated by lever underneath—obstruction not objectionable.

8TH TEST.—The close fitting sliding surfaces over which breech-block revolves were so rusted that the breech could not be opened. A liberal application of oil loosened the rust and three 45-grain cartridges [N] were fired.

9TH TEST.—Sand working down upon the gearing entirely disabled the gun, nor could it be removed except by dismounting the piece.

10TH TEST.—Distributed in five minutes and assembled in nine minutes.

III.—THE MORGANSTEIN BREECH-LOADER.

Entered by Mr. WILLIAM MORGANSTEIN,
Philadelphia, Pa.

DESCRIPTION.

The gun having been withdrawn before a complete examination and application of tests could be made, no description of the gun can be given. The following tests were made before withdrawal.

TESTS.

1ST TEST.—Fired with 60-grain cartridges thirty-eight times in four minutes and thirty seconds, when the gun was temporarily withdrawn, the cartridges not being fitted for the chamber and great difficulty experienced in retracting the cases—until finally it became impossible to insert or withdraw the cartridges except by instrumental aid. On second trial ninety-nine 60-grain cartridges were fired in nine minutes and fifteen seconds.

3D TEST.—Fired by inventor and average of three trials twelve times per minute, of which five balls entered target.

9TH TEST.—Not materially affected by sand. (This gun withdrawn before it could be submitted to other tests.)

IV.—THE NATIONAL RIFLE AND CARBINE.

Entered by the NATIONAL ARMS COMPANY,
Brooklyn, N. Y.

DESCRIPTION.

Length of barrel, $32\frac{1}{2}$ inches. Calibre, .50. Adapted to rim-fire cartridges. Weight of entire arm, 8 lbs. 4 oz.

Barrel screwed into breech-receiver. The breech-block, which presses against the cartridge-head, and the recoil-block are solid rectangular prisms, filling the receiver and transmitting the recoil directly and in line of axis of barrel to the recoil-seat. Both the blocks are operated by the same lever working beneath the receiver. Upon depressing the lever, the recoil-block is forced down until its upper surface is on the same

horizontal plane as the lower surface of the breech-block, when the latter block passes back horizontally and over the recoil-block, opening the breech for introduction of cartridge. The retractor has a positive motion, and is operated by the breech-lever. Side lock with back action.

TESTS.

1ST TEST.—Ninety-one 60-grain cartridges [L] were fired (and eight that missed fire inserted and withdrawn) in seven minutes and forty-five seconds. Then fired with 60 grains powder and two balls of 380 grains each; the result satisfactory, the mechanism of the piece not being affected.

2D TEST.—With 60 grains powder and 380 grains lead, penetrated the eleventh board.

3D TEST.—Fired, on behalf of exhibitors by Mr. Bergen, eleven times in one minute, seven balls striking the target. Fired by private soldier nine times in one minute.

4TH TEST.—Mechanism strong and not complicated.

5TH TEST.—Fired with a 60-grain cartridge [L] filed three-quarters round the flange; failed to affect the breech or appendages, the gas, however, escaping through aperture beneath and in front of breech-block would severely burn the hand or arm of person firing. In another gun, in which a larger vent for the gas was allowed, two similar cartridges, the heads of which had been filed half way round, were fired, the breech and machinery unaffected, but same objection as before noticeable, the hand (especially in drawing it toward the breech, resting elbow against the body in taking steady aim) would be burned. The gun was then withdrawn, and subsequently presented with provision for escape of gas upward, and was fired by Mr. Bergen from the shoulder with a 60-grain cartridge, filed through. There was considerable escape of gas upward and a small quantity beneath. The trial was deemed satisfactory. Fired with similar cartridge split longitudinally, without affecting the breech.

6TH TEST.—Cannot be prematurely discharged, nor cartridge dropped from chamber.

7TH TEST.—In this respect same as other breech-loaders, operated by lever beneath. Not objectionable.

8TH TEST.—It was impossible to move the breech-block; the

rust on the large sliding surfaces resisted the entire power of the lever. After being well oiled, the rust was softened and the breech moved, and three 45-grain cartridges were fired, the piece working well.

9TH TEST.—Sand somewhat crippled the action of the breech, but after thorough concussion and cleansing with the fingers, most of it was removed, and the cartridge introduced with some difficulty, but discharged and case retracted.

10TH TEST.—Dismounted and distributed in one minute and forty-five seconds, and assembled in three and a half minutes.

V.—THE POULTNEY BREECH-LOADING RIFLE.

Entered by MR. POULTNEY, Baltimore, Md.

DESCRIPTION.

Length of barrel, 36 inches. Calibre, .50. Adapted to central-fire cartridges. Weight of entire arm, 10 lbs. 8 oz.

The barrel is screwed into a breech-receiver. The breech-block and lever are in one piece, the pivot of rotation or fulcrum being below the line of axis of barrel. The face of the breech-block is a plane, the top and rear being rounded in the arc of a circle described around the pivot. The lever being depressed, the block makes a quarter revolution, so that the face passes from a vertical to a horizontal position, parallel to the axis of barrel, and in a plane passing through the lowest line of the chamber, so that the cartridge placed upon it is guided into position. When the breech is closed, by bringing the lever back and up, it is locked by a hook-catch attached to rear part of the lever, and hooking into a solid-iron receiver inserted in under side of the stock. A spiral spring insures the action of the hook, which is disengaged by a thumb piece on the lever. The pivot of rotation is a steel pin, which, however, does not receive the recoil, which is transmitted directly to the recoil-seat back of the

breech-block. The retractor is positive, without springs, and the case is ejected by sudden movement of the lever. Has a side lock, with back action. Firing-pin passes through breech-block in usual form and manner.

TESTS.

1ST TEST.—Ninety-nine 60-grain cartridges [K] were fired in seven minutes and twelve seconds. Then fired with 60 grains powder and two balls of 435 grains lead each. The breech and appendages were not affected, and the various parts worked well.

2D TEST.—With 60 grains powder and 435 grains lead penetrated the thirteenth board.

3D TEST.—Fired for inventor by Mr. A. G. Sinclair thirteen times in fifty-seven seconds, four balls striking the target. Fired by private soldier seven times in sixty-two seconds.

4TH TEST.—Mechanism strong and simple.

5TH TEST.—Fired with a 60-grain cartridge [K] filed half way round on head; the breech-block opened about three-sixteenths of an inch, the latch-hook on lever being loosed. The inventor having convinced the Board that this result was occasioned by imperfect workmanship, the face of the latch-hook having been filed off (as was evident on inspection), he was allowed to enter another and more perfect gun, which was fired twice with 60-grain cartridges filed around the flange two-thirds the circumference, without opening the breech or otherwise deranging any part. The friction-spring was then taken out of the hook lever and the gun fired with cartridge similarly prepared and with result as satisfactory. Fired with similar cartridge split longitudinally without affecting any part.

6TH TEST.—Secure against premature discharge. The loss of cartridge would depend on the efficiency of the lever-hook.

7TH TEST.—Unobjectionable.

8TH TEST.—Unaffected by rust; breech opened and closed with ease. Three 60-grain cartridges fired with satisfactory results.

9TH TEST.—Sand readily dislodged by ordinary means.

10TH TEST.—Distributed in two minutes and assembled in three minutes and thirty seconds.

VI.—THE PEABODY BREECH-LOADING RIFLE.

Entered by PROVIDENCE TOOL COMPANY ARMORY, JOHN
B. ANTHONY, Treasurer, Providence, R. I.

DESCRIPTION.

Length of barrel, 35½ inches. Calibre, .50. Adapted to rim-fire cartridges. Weight of entire arm, 9 lbs. 14 oz.

The barrel is screwed into a breech-receiver. The breech-block consists of a solid prism, pivoted at the upper part of rear end, the face being at right angles to axis of barrel except the upper quarter, which is slightly rounded off in order to pass readily over the cartridge-head, and also to allow revolution on the pivot so as to pass below the chamber. The upper side of block has a spoon-like groove which coincides with bottom of chamber when the breech is open, guiding the cartridge to its place. The guard-lever is pivoted upon the lower edge of receiver, and being an elbow-lever with the short arm directed toward fulcrum-pin of the breech-block, and terminating in a notch in the end of same, so that when the lever is thrown forward the block is depressed. The extractor is another elbow-lever; the breech-block in moving down strikes the short arm of this lever and the other arm draws the cartridge; the impact of the breech-block being first at the end of the lever giving power to draw the case, gradually approaches the fulcrum, giving increased motion to eject it. The breech-block revolves on a rounded projection in its rear, moving in corresponding cavity in the recoil seat, thus giving a secure bearing, the pivot serving simply to keep the block in place. A brace-lever is pivoted to the breech-block three-quarters of an inch from its face, and lying in a recess in under side of the block, with a strong spring between the

brace and block pressing the back end of the brace upon a friction roller ; the entire combination fastening securely the breech-block and guard-lever in place when the breech is closed. The lock is an ordinary back-action lock, and firing-pin in usual shape.

TESTS.

1ST TEST.—One hundred 60-grain cartridges [M] were fired in four minutes and fifty-five seconds. The gun barrel was highly heated and much fouled, but the mechanism of the breech worked well. Rigidly held in the fixed rest in a horizontal position, the empty cases were thrown back against the hammer and had to be removed now and then, but in actual practice this would not frequently occur, nor at the worst be a serious disadvantage. Fired then with 60 grains powder and two balls of 435 grains lead each—result entirely satisfactory.

2D TEST.—With 60 grains powder and 435 grains lead penetrated to the eleventh board.

3D TEST.—Fired by the inventor twelve shots in one minute, nine of which entered the target. Fired by private soldier.

4TH TEST.—Mechanism strong and simple ; no springs used in the retractor. The only spring being attached to the brace-lever—this lever and spring being removed the gun was fired several times, the breech being closed by the hand pressed on the lever and also by simply binding with a slight cord, showing that these parts are essential only as a friction or pressure lock to keep breech closed.

5TH TEST.—Fired twice with 60-grain cartridges [M] filed all around the flange so as to burst head out, without affecting the mechanism. Fired with similar cartridge split longitudinally with same result.

6TH TEST.—To determine if the breech could be left partially open and the gun fired with impunity, the breech-block was dropped one-eighth of an inch below position when closed and secured there, then fired with 60-grain cartridge without any noticeable effect on the mechanism or escape of gas. The breech-block was then dropped about three-sixteenths of an inch and a 60-grain cartridge fired with same result as before. At any point below the last the hammer would fail to explode the cartridge. The cartridge in chamber not likely to be lost out as the locking device secures the breech-block in place.

7TH TEST.—Not more objectionable than muzzle-loaders as the breech-lever is about the same as ordinary trigger-guard.

8TH TEST.—Breech opened and closed readily, and all parts worked freely. Fired thrice with 60-grain cartridges [M] with satisfactory results.

9TH TEST.—Sand was readily dislodged without disabling the gun and several cartridges were fired with satisfactory results.

10TH TEST.—Distributed in thirty seconds and assembled in one minute.

VII.—THE REMINGTON IMPROVED BREECH-LOADING RIFLE.

Entered by F. REMINGTON & SONS, Ilion, N. Y.

DESCRIPTION.

Length of Barrel 30 inches. Calibre .50. Adapted to rim-fire cartridges. Weight of entire arm 8 lbs. 2 ozs.

The breech mechanism and lock action are in this arm combined. The barrel is screwed into a breech receiver. The breech-block consists of a solid piece of metal revolving on a steel pin (half inch in diameter) the pin being bisected by a plane passing through the rear of chamber and its centre .72 of an inch below axis of barrel. Immediately above the face of the block is a projecting thumb-piece for manipulating the block, back of which it is worked to a circle described from centre of pin. The hammer moves upon a similar pin, the centre being 1.47 inch back of centre of block pin and 1.42 inch below the line of axis of barrel. The hammer and tumbler are in one piece. The rear of the breech-block revolves in corresponding concavity in the hammer block, and the recoil bears upon both the pivots of revolution. To open the breech the hammer is placed at half-cock the breech block then drawn back by means of the thumb-piece, the cartridge inserted and breech closed by means of the thumb

piece. When closed it is locked by the hammer which rests immediately upon the rear of the breech-block, through which the firing pin passes. The retractor is positive, without springs and operated by means of a lip on the breech-block. In a lately modified arm exhibited to the Board the act of cocking the hammer opens the breech without other motion, and the breech is locked independently of the hammer. The breech mechanism of this arm is remarkably simple, taken in connection with the lock.

TESTS.

1ST TEST.—Ninety-nine 60-grain cartridges [L] were fired in six minutes and fifty-one seconds; then fired with 60 grains fine rifle powder and two balls of 380 grains each. The result entirely satisfactory, the breech mechanism not being in any way impaired, all parts working well.

2D TEST.—With 60 grains fine powder and 380 grains lead penetrated the twelfth board.

3D TEST.—Fired by Col. Squire on behalf of exhibitors eleven times in one minute, six balls striking the target.

4TH TEST.—Mechanism remarkably simple and strong.

5TH TEST.—Fired twice with 60-grain cartridges [L] filed on the head two-thirds around without in any way affecting the gun. A similar cartridge split longitudinally was fired with same result.

6TH TEST.—Cannot be fired unless breech is fully closed, nor can cartridge be lost from chamber.

7TH TEST.—Same as muzzle-loader.

8TH TEST.—Not affected by rust, though hammer was difficult to move, but after working to and fro several times recovered its ease of motion, and three 60-grain cartridges were fired with satisfactory result.

9TH TEST.—On first trial upon introduction of sand the parts were attempted to be worked without first blowing or brushing off the sand in the manner allowed, and did not move with entire freedom; but thorough trial subsequently proved that this arm would stand this test to the entire satisfaction of the Board.

10TH TEST.—Distributed in twenty-five seconds and assembled in forty-five seconds.

VIII.—THE ROBERTSON & SIMPSON BREECH-LOADING GUN.

Entered by Messrs. ROBERTSON & SIMPSON,
Hartford, Conn.

DESCRIPTION.

Length of barrel, 22 inches. Calibre .50. Adapted to rim-fire cartridges. Weight of entire arm, 8lbs. 13oz.

Barrel screwed into a breech-receiver. The breech-block pivoted to receiver at a point below the bottom of the chamber and about three-quarters of an inch back of perpendicular, falling through rear of chamber. The guard-lever is pivoted on the lower edge and front end of receiver, the centre being vertically below rear of chamber; about one-fifteenth inch back of pivot of guard-lever is pivoted to it a link, the other end of which is pivoted to the lower end of the breech-block. From centre to centre of pivots of link is about one inch, and from pivot of link on breech-block to pivot of revolution of latter is about $1\frac{1}{4}$ inches. The guard-lever and block are connected only by intervention of this link. When the breech is closed the centre of link pivot on the guard-lever is above and forward of a line drawn through the centre of the link pivot on the breech-block and the pivot of revolution of the guard-lever, and any recoil against the face of the block tends to draw the lever up and secure the breech. By depressing the lever, the breech-block revolving on its pivot falls back sufficiently for easy insertion of the cartridge. The recoil is transmitted directly from the block to the recoil seat. There are two retractors, composed of peculiarly bent levers pivoted on each side of breech-block and worked from a short arm to a long one, giving rapidity of motion to eject the shell without the employment of springs.

TESTS.

1ST TEST.—Ninety-nine 45-grain cartridges [N] fired in eight minutes and thirty seconds; then fired with 45 grains powder and two balls of 335 grains lead each, the gun operating well.

2D TEST.—With 45 grains powder and 335 grains lead penetrated the eleventh board.

3D TEST.—Fired by Mr. G. W. Simpson nine times in a minute, five balls striking the target. Fired by private soldier seven times in one minute.

4TH TEST.—Strong and not complicated.

5TH TEST.—Fired twice with 60-grain cartridges [L] filed on two-thirds of the rim, without in any manner affecting the mechanism. Same result on firing similar cartridge split longitudinally.

6TH TEST.—Unobjectionable.

7TH TEST.—Same as other good lever guns.

8TH TEST.—Surfaces were well rusted, but breech opened and closed by ordinary action of lever, though working hard. Three 45-grain cartridges fired with satisfactory results.

9TH TEST.—On first trial, gun completely disabled, the sand lodging back of breech-block, and the working parts being closely fitted, it could not be readily removed. The gun, being withdrawn, was repaired and modified, and upon reapplication of the test worked tolerably well.

10TH TEST.—Dismounted in one minute and five seconds, and assembled in one minute and fifty-five seconds.

IX.—THE SHARP'S BREECH-LOADING RIFLE.

Entered by SHARP'S RIFLE MANUFACTURING Co.,
Hartford, Conn.

DESCRIPTION.

Length of barrel, $22\frac{1}{4}$ inches. Calibre, .50. Adapted to rim-fire cartridges. Weight of entire arm, 8 lbs.

Barrel screwed into breech receiver. A sliding breech-block, moving nearly at right angles to axis of barrel, operated by a lever pivoted to lower front part of receiver. As the lever is depressed, the breech-block is drawn down and slightly back from a perpendicular, dropped from the rear of the chamber, the cartridge

being inserted and the lever drawn up, the block moves up with a wedging motion, pressing the cartridge to its place; this wedging motion is about one-eighth of an inch. The firing-pin passes through the breech-block in the usual manner. The retractor is an elbow lever, with a long and short arm, operated by the end of the guard lever, and drawing the shell and ejecting it. The gun, except slight modifications to adapt to the metallic ammunition, is in all respects the same as the paper or linen cartridge guns from the same source, and possesses the same merits in regard to strength and perfection of workmanship.

TESTS.

1ST TEST.—Ninety-nine 60-grain cartridges [L] fired in six minutes and forty-eight seconds. Then fired with 60 grains fine rifle powder and two balls of 380 grains each. The test entirely satisfactory.

2D TEST.—With 60 grains electric powder and 380 grains lead, penetrated the thirteenth board.

3D TEST.—Fired for exhibitors by Mr. R. S. Lawrence, thirteen times in one minute, eleven balls striking the target. Fired by private soldier eight times in fifty-eight seconds.

4TH TEST.—Mechanism very strong and simple.

5TH TEST.—Fired twice with 60-grain cartridges [L] filed on the rim, without affecting the gun. Same result with similar cartridge split longitudinally.

6TH TEST.—In order to determine if a cartridge partially inserted would be exploded by the breech-block being forced into place, a 45-grain cartridge was placed in the chamber with the head protruding three-thirty-two parts of an inch, and the breech suddenly and forcibly closed. The block crushed in the fulminated rim of the cartridge without igniting it. The cartridge can be fired only when breech is closed, and cannot be dropped from chamber.

7TH TEST.—The same as other lever guns.

8TH TEST.—The working parts were well rusted, but were readily moved by ordinary action of the lever, and three 45-grain cartridges were fired with satisfactory results.

9TH TEST.—Sand entirely disabled the gun, the granules working behind the retractor, and preventing the breech from being closed.

10TH TEST.—Dismounted and distributed in fifty-six seconds, and assembled in one minute and twenty-six seconds.

X.—THE THUNDERBOLT BREECH-LOADING RIFLE.

Entered by HOWARD BROTHERS, New Haven, Conn.

DESCRIPTION.

Length of barrel, 33 inches ; 6 grooves Calibre, .46. Adapted to rim-fire cartridges. Weight of entire arm, 9 lbs.

Combined breech mechanism and lock. A slot is cut through the under side of the barrel (in front of the breech-pin), sufficiently large for insertion of the cartridge and to attach the guard lever to the sliding-bolt or breech-block. The guard lever at about two inches from its forward end is pivoted by the intervention of a curved link to the barrel just forward of the trigger, the extreme end of lever being pivoted to the breech-block, which is a circular bolt just fitting the bore of the chamber. When the lever is depressed till at right angles to the barrel, the breech is fully open and the operation of closing, cocks the piece ; by pressing slightly on the trigger, in closing the breech, the gun is not cocked, but can be cocked by depressing the guard a short distance. The lock consists of a hammer-rod and spiral spring inclosed within the receiver, back of breech block. When the block is slid back to open the breech, the sear of the trigger catches into the notch of the hammer-rod and holds it, then as the breech-block is returned, the spiral spring is compressed and the hammer-rod being released by pulling the trigger, the

spring throws it forward against the firing pin. The retractor has a positive motion and is operated by the guard lever.

TESTS.

1ST TEST.—Ninety-nine 45-grain cartridges [P] fired in four minutes and fifty seconds; then fired with 45 grains of powder and two balls of 300 grains lead each. The mechanism of the gun operated well and was in no manner deranged.

2D TEST.—With 60 grains powder and 370 grains lead penetrated the eleventh board. Second trial with same charge penetrated the fourteenth board.

3D TEST.—Fired by Mr. Howard sixteen times in one minute, four balls striking the target.

[The time limited by the Board for actual trials having expired, this gun could not be submitted to further tests.]

MAGAZINE OR REPEATING ARMS.

I.—BALL'S REPEATING AND SINGLE-LOADING CARBINE.

Entered by the WINDSOR MANUFACTURING COMPANY,
Windsor, Vt.

DESCRIPTION.

Length of barrel, 22 inches. Calibre, .50. Adapted to rim-fire cartridges. Weight of entire arm (unloaded), 7 lbs. 12 oz. Weight with magazine charged (nine cartridges), 8 lbs. 5½ oz.

The necessarily more or less complicated mechanism of a repeating arm renders a merely verbal description unsatisfactory and incomplete, as the aid of diagrams is necessary to an intelligible illustration; brief mention therefore will be made, and only regarding the more remarkable features of the arm. The magazine is a brass tube incased in the stock, immediately beneath the barrel, the cartridge being propelled toward the breech by the agency of a spiral spring; at the mouth of the magazine is a "cut-off," by which the passage of the cartridges is prevented when they are to be held in reserve and the arm used as a single-shooter.

The carrier-block receives the cartridge from the magazine, and by a most ingenious movement carries it to its place in the barrel, being operated by a lever be-

neath. The chamber is partly in the barrel and the remainder in the carrier-block which supports the cartridge during the explosion, the recoil being transmitted through the recoil-brace to the recoil-seat, the brace being operated by a safety-wing attached to the tumbler of the lock, by which means also a premature explosion is prevented. The ejector not only expels the cartridge-case, but also holds the cartridge in the block as it is carried into the barrel.

TESTS.

1ST TEST.—Discharged ninety-nine 45-grain cartridges [N] in six minutes and thirty seconds, the magazine (holding nine cartridges) being filled eleven times. Of this number only 75 exploded, the remaining 24 being fed to the chamber and ejected. These cartridges were then again placed in the magazine and fired. The breech was not affected nor the mechanism in any way deranged.

2D TEST.—With 45 grains powder and 335 grains lead, penetrated the twelfth board.

3D TEST.—Being fired several times for exhibitor the best result was sixteen shots in one minute, the magazine being emptied and seven additional cartridges inserted in the chamber, of which ten balls struck the target. Fired by private soldier nine times in one minute, of which thirty-four seconds were occupied in filling the magazine.

4TH TEST.—Complicated as is unavoidable in a repeating arm, but apparently stable.

5TH TEST.—Fired with a 45-grain cartridge filed on the rim half way round, the breech remaining closed and mechanism unimpaired, but a piece of the stock between the lock and tang was blown off by the reaction of the gas. Fired with similar cartridge split longitudinally without affecting the arm.

6TH TEST.—Secure against premature discharge or loss of the cartridges from magazine. (In regard to explosion of cartridges in magazine see report on cartridges beyond.)

7TH TEST.—Unobjectionable.

8TH TEST.—Breech opened and closed easily and three cartridges fired with satisfactory results.

9TH TEST.—Sand greatly obstructed the action of this arm and it could be dislodged only after laborious effort. After thorough cleaning, a cartridge was introduced and discharged.

10TH TEST.—Time of distribution and assembling not recorded

II.—THE SPENCER REPEATING RIFLE.

Entered by "SPENCER REPEATING RIFLE Co.,"
Boston, Mass.

DESCRIPTION.

Length of barrel, $29\frac{1}{2}$ inches. Calibre .50. Adapted to rim-fire cartridges. Weight of entire arm (unloaded), 10 pounds; with magazine filled, $10\frac{1}{2}$ pounds.

As remarked in regard to the "Ball Carbine," a merely verbal description of a repeating arm is impossible. The Spencer rifle having been extensively used during the late war, is probably better known than any other similar arm. The magazine is located in the stock in the butt of the gun, and contains seven cartridges, which can be held in reserve and the gun used as a single-shooter. The carrier and breech-blocks and the ejector are operated by a lever beneath.

TESTS.

1ST TEST.—Fired ninety-nine 60-grain cartridges [I] in eight minutes and twenty seconds, the magazine being successively filled and exhausted; then fired with 60 grains powder and two balls of 380 grains lead each. The result entirely satisfactory, the arm working well in all respects.

2D TEST.—With 60 grains powder and 380 grains lead, penetrated the eleventh board.

3D TEST.—Fired by Mr. Spencer nine times in one minute, seven balls striking the target, the magazine containing seven cartridges, and two being loaded at the breech. In firing by private soldier the ejector broke, there being a flaw in the metal, and the trial was not completed.

4TH TEST.—Complicated, as in all repeating arms, but strong and well constructed.

5TH TEST.—Owing to breakage of ejector, as noted above, the trial with imperfect cartridges was not made. (Reference is directed to experiment with central-fire cartridges, in report on “cartridges,” beyond.)

6TH TEST.—Secure in these respects.

7TH TEST.—Unobjectionable.

8TH TEST.—Breech opened and closed readily.

9TH TEST.—Not affected by sand, which was easily dislodged.

10TH TEST.—Time occupied in distribution and re-assembling not recorded.

III.—GRAY'S REPEATING CARBINE.

Entered by MR. JOSHUA GRAY,
Boston, Mass.

This arm was not prepared for submission to all the tests, the one presented being a model, a portion of the working parts being made of a composition metal. It appeared to the Board to possess several distinctive and meritorious features. The magazine, containing seven cartridges, lies immediately beneath and parallel to the barrel. Using the charges in the magazine, and then firing as a single-loader, it was discharged twenty times in one minute and forty-five seconds.

In addition to the foregoing, the Winchester Repeating Rifle was exhibited to the Board, by Mr. Winchester, who, however, could not spare an arm for the trials.

TABLE OF CARTRIDGES USED IN THESE TESTS.

Entire Cartridge.			CASE.				PROJECTILE.				POWDER.		Weight of Lubricant—grains.
Length—inches.	Weight—grains.	Metal.	Length.		Diameter of Flange	Diameter of Cylinder.		Entire Length.	Greatest Diameter.	Number of Grooves.	Weight—grains.	Quality.	
			Outside of Flange.	Inside of Flange.		At Base.	At Mouth.						
A.....	2.50	726	Brass...	1.97	1.90	.75	.69	.61	1.45	3	460	Gov't Standard...	(a) 31
B.....	2.05	682	do	1.51	1.43	.75	.65	.62	1.18	3	486	do	8
C.....	1.88	638	Copper, ..	1.37	1.31	.70	.63	.62	1.05	3	475	do	3
D.....	1.72	638	do	1.21	1.14	.70	.63	.62	.95	3	480	do	6
E.....	1.72	642	do	1.22	1.15	.70	.63	.62	.97	3	480	do	2
F.....	1.70	632	Brass...	1.33	1.26	.70	.63	.62	(c)	3	480	do	5
G.....	1.70	835	Copper, ..	1.21	1.15	.71	.66	.61	1.57	3	480	do	5
H.....	2.30	685	do	1.76	1.69	.67	.56	.55	.97	3	670	Fine Rifle.....	8
I.....	2.26	637	do	1.74	1.67	.64	.56	.55	1.33	3	480	Gov't Standard...	8
J.....	1.98	617	do	1.46	1.38	.66	.56	.55	1.02	4	462	Gov't Rifle.....	3
K.....	1.91	524	do	1.45	1.38	.64	.56	.54	(d)	3	435	Fine Rifle.....	3
L.....	1.98	585	do	1.45	1.38	.64	.56	.55	.85	3	380	Gov't Standard...	4
M.....	1.61	460	do	1.45	1.08	.63	.56	.55	1.00	3	435	do	4
N.....	2.20	535	do	1.46	1.40	.63	.56	.55	.80	3	335	do	5
O.....	1.61	423	do	1.07	1.01	.65	.56	.50	.92	3	370	do	3
P.....	1.61	423	do	1.07	1.01	.65	.56	(f)	.75	3	300	do	3
Q.....	1.35	266	do84	.77	.52	.45	.45	.45	1	193	do	2

(a) Fifteen grains of wax, etc., and two felt discs weighing 16 grs.

(b) A conical cavity in base with base and depth of .42 inch.

(c) Four grains of wax, etc., and one felt disc of 4 grs.

(d) The last .13 of inch crimped to diameter of .53 inch.

(e) Includes iron disc which strengthens the head.

(f) Groove .15 inch wide and .03 inch deep.

(g) Includes weight of iron anvil.

(h) Cylindrical from flange to distance of 1.04 inch, with diameter of .56 inch; then suddenly crimped to diameter of .50 inch.

(i) Cylindrical from flange to distance of 1.59 inch, with diameter of .56 inch; then suddenly crimped to diameter of .49 inch.

The several arms examined and tested by the Board may be divided into five distinct classes or systems, based upon the attachment and movement of the breech-block.

1ST CLASS.—The breech-block hinged to front or rear of receiver and moving in a plane parallel to the axis of the barrel: in which are included the Allin, Berdan, Hubbell, Joslyn's swing-breech, Lamson, Milbank, and Montstorm, all adapted to conversion of muzzle-loaders.

2D CLASS.—The breech-block hinged to the left hand side of receiver and moving in a plane at right angles to the axis of the barrel; including the Empire No. 1, and the Joslyn's Cap, both being adapted to conversions.

3D CLASS.—The breech-block moving on a pivot at its rear end, and the forward end dropping in the receiver below the chamber, for insertion of cartridge; including the Roberts, adapted to conversion, and the Peabody intended for original arms.

4TH CLASS.—The breech-block pivoted at its lower front portion, near the front of receiver and below the level of chamber, revolving in a vertical plane passing through axis of barrel, falling back to open the chamber and forward to close it; including the Miller, Poultney, Remington and the Robertson and Simpson, all intended for original arms.

5TH CLASS.—The breech-block sliding in the receiver, either horizontally or vertically, including the Gray and the Meigs, both adapted to conversion, and the Ballard, National and Sharps, intended for original arms.

In addition to which classification is the Empire No. 2, having no moveable breech-block, the motion being in the barrel.

After careful deliberation and discussion the Board has concluded:

1st. That in the arms included in classes 1 and 2, there is an objection to the extensive movement of the breech-block, upward and forward in opening the breech and *vice versa* in closing it. And furthermore that it is an undecided question whether the hinge attachment is sufficiently stable to withstand the trial of long continued service.

2d. That breech-blocks hinged as in classes 1 and 2, require for their efficient locking when closed, some suitable device independent of the friction of the parts or the resistance of recoil.

3d. That breech-blocks hinged as in class 2, on the left hand side of the barrel, are awkward and inconvenient for the execution of the manual of arms in loading and firing.

4th. That arms of class 3, having breech-lever above the stock are objectionable as the location of the lever involves a constrained position of the arm, with consequent loss of power or an alternative change of position of the gun to readily operate the lever in loading and firing.

5th. That large sliding surfaces, as generally used in class 5, are objectionable, as being readily affected by rust, dust and sand, and probably by wear upon the bearing surfaces by continued use.

6th. That any movement of the barrel is objectionable, as it should be the stable part of the arm, the "bed plate" (to borrow a term) to which the lighter parts are attached; and that from its superior weight and the unavoidable division of the stock, its movement relative to the other parts is in itself a source of weakness, which would probably increase with continued service.

7th. That extensive lever movement is objectionable as prolonging the time occupied in its action, and the liability of accidentally bending the lever or otherwise deranging the arm, when the breech is open and the lever at its greatest angle with axis of barrel.

8th. That the retraction of the cartridge case should be by a positive motion and by strong and durable appliances, and that dependence upon springs to eject or accelerate the motion of the case is objectionable, as they are liable to breakage or loss of power and furthermore as the same result may be obtained by rapidity of motion applied to the retractor.

9th. That openings through the chamber or bottom of receiver are objectionable, whether made for passage of retractor or ejector, or for other purposes, as affording opportunity for the passage and action of gas if cartridge case should burst, or of water when exposed to the weather.

10th. That the firing pin should be strong and in not more than two parts, acting as nearly as possible in the same straight line, but preferably in a single piece.

And furthermore the Board would specially report :

11th. That in the conversion of arms now owned by the State, the re-enforcement of the barrels of .577 and .58 calibre in order to reduce them to .45, or .50, or other smaller calibre, by reaming out the grooves and inserting a tube, is not desirable ; for while it is conceded that such reduction may, in some degree, increase the accuracy, penetration and range, it is concluded that such increased efficiency is not commensurate with the additional cost and weight required to insure it, nor is the Board entirely satisfied that the processes thus far adptead for such reduction of calibre are such as to secure a permanent adhesion of the two tubes after prolonged service. But in the manufacture of new arms the Board recommends the adoption of the calibre of .50, as giving the best results in regard to range, accuracy and penetration, combined with the most convenient form of cartridge.

12th. That the experiments made by the Board were not sufficiently extended to determine the result of reduction of the size of working parts by continued wear in service, which could not be simulated by filing or other artificial means, and that such result could be obtained only by actual trial, by submitting the arms to the established maximum of discharges, combined with such rusting and cleaning as such number would properly represent.

Of the arms presented to and tested by the Board, it reports as follows :

I. Of those adapted to the conversion of muzzle-loaders, they deem the ALLIN, the BERDAN, and the ROBERTS as superior in all respects to any and all the others. But each of these arms possessing distinctive features, more or less meritorious in themselves and in their combination, the Board recommends a further and more extended competitive trial of these several arms, under such rigid regulations and requirements as the Board may establish, to which regulations and requirements the several competitors shall consent and subscribe before entering their arms.

Of the remaining arms adapted to conversion, the Board would place in order of merit, as follows :

4th. JOSLYN'S CAP GUN. Objecting to insufficiency of recoil seat, and to the weakening of stock, by cutting away.

5th. MEIGS' ALTERATION. Reference being made to the 6th point in the conclusions above recited ; to failure under the 8th test, and also to the slightness of guard plate and appendages which are liable to bending and consequent increased friction in operation.

6th. GRAY'S GUN. Objection being made to extensive movement of lever and breech-block, and to failure under the 5th test.

7th. MILBANK'S ALTERATION. Objection being made to cutting away the barrel too much to form receiver, and weakening same, and failure under the 5th test.

8th. LAMSON'S GUN. Serious failure under the fifth test. (Since the close of trials by the Board, this gun has been exhibited to the members with such improvements as would obviously appear to avoid the serious objections made to it, and render it capable of resisting the explosion of an imperfect cartridge case.)

II. Of original arms not adapted to conversion, the Board would report in order of merit, as follows :

1st. THE REMINGTON RIFLE, with latest improvements as exhibited to the Board.

2d. THE PEABODY RIFLE.

3d. THE POULTNEY RIFLE. Objection being made to dependence on hook-catch to secure the locking of breech.

4th. THE NATIONAL RIFLE. Reference being made to 5th conclusion of the Board and failure under 8th test.

5th. ROBERTSON & SIMPSON. Reference being made to the 6th conclusion of the Board and partial failure under 9th test.

6th. SHARP'S RIFLE. An exceedingly strong and durable arm, but failed entirely under 9th test. Better adapted to paper or linen cartridges as originally intended.

7th. BALLARD'S RIFLE. Liable to be clogged by sand or rust, and to objections recited in 6th conclusion.

8th. MILLER'S RIFLE. Mechanism too complicated and entirely deranged by 9th test.

III. In regard to Magazine or Repeating Arms, the Board is convinced that, for the present, their use should be confined to the cavalry service, as an examination of the record shows that single breech-loaders are capable of being fired at least as many times per minute as a repeating arm, and are more simple in construction and less liable to derangement.

In cavalry service, the proper management of the horse in action may render the repeating arm desirable, as relieving the soldier from the embarrassment of loading in critical periods. The limited force of cavalry in the State service renders a decision on this point unimportant, and the Board recommends a delay in the selection and purchase of repeating arms, as several new inventions are now being perfected and will soon be presented for trial and competition.

CARTRIDGES.

The metallic case cartridge being the most important element in modern breech-loading arms, as providing an efficient gas check and abbreviating the time and simplifying the process of loading, the Board has carefully examined the various kinds used in the respective arms and have formed certain conclusions, as follows:

1st. That the cartridge case should be considerably conical, as being more readily inserted and retracted from the chamber, which should be made conical to correspond with the case.

2d. That the fulminate should be confined to the centre of the head of the case, and not in the rim; this system known as the "central fire" is preferable, as producing a more regular ignition of the powder; not being liable to excess of fulminate and consequent danger in explosion; greater thickness of metal is allowable in the rim, where the greatest strength is required; being less hazardous in transportation; admitting of greater strength and simplicity in the firing pin, and allowing the cases to be readily reloaded if desirable.

3d. That brass is the preferable material for the cases of central-fire cartridges, as it can be used without an anvil for impact of fulminate, the metal being stiffer; from its elasticity the case resumes its shape and size after explosion, and is more readily retracted, and can be reloaded; and it is a cheaper ma-

terial, and is not liable to be cut through by retractor when, on account of any friction or derangement, the case resists its action.

4th. That rifle powder is preferable to musket powder in metallic cartridges, and that sixty grains is a sufficient charge with four hundred and eighty grains of lead. It was noted that when seventy grains of musket powder were used, a portion was expelled from the barrel unconsumed, and after many discharges, the arm was disproportionately fouled.

5th. That the balls should be well lubricated in the grooves, and also that provision should be made for a lubrication and cleansing immediately after the passage of the ball. The lubricant should be so constituted as to resist, without melting, a heat of 140° Fahr.

Several minor points were elucidated by the trials of the Board, and reference is made to the record of the Hubbell and Lamson guns under trial of the first test, as exhibiting the effects of insufficient lubrication. It will also be noted that none of the arms were affected by the split cartridge in the fifth test.

In order to determine whether central-fire cartridges in the magazine of a repeating arm could be accidentally exploded by percussion, as in the movement of "order arms" in infantry, or the dropping of a carbine by a mounted cavalry soldier, such percussion driving the apex of the bullet of one cartridge into the centre of the head of the next, the following experiment was made:

· Into the barrel of a musketoon, calibre .69, and the entire arm weighing $9\frac{1}{4}$ pounds, there were dropped, with the heads down, six cartridges (II, Table of cartridges, page 56). The musketoon was then dropped a distance of four feet, the butt striking forcibly the floor, and, subsequently, several bricks placed beneath, to obtain a more inelastic impact. The experiment having been repeated several times without producing explosion, it was found upon examination that the apex of the bullets had been flattened so as to present a plane of over 3-16 of an inch in diameter, and consequently with reduced liability to produce explosion. It is, therefore, a reasonable deduction that central-fire cartridges, with bullets of unalloyed lead, are

not liable to explosion by violent percussion in the magazines of repeating arms.

In concluding the subject of cartridges, the Board desires to commend the system of H. Berdan, whose brass-case central-fire cartridges possess peculiar merits, combining in a high degree many of the requisite points hitherto mentioned. The powder used in these cartridges deserves special mention, as being very superior. It is the Orange Rifle Powder [F], manufactured by Messrs. Smith & Rand. Several improvements have been made in the Berdan cartridges since those described in the table were used.

In this connection the Board desires to specially commend the new cartridge box, adapted to metallic cartridges, invented by Brevet Major-General William H. Morris, late U.S. Vols., and exhibited by that gentleman to the Board. This cartridge box is intended not only as a model for the manufacture of new ones, but is adapted to the conversion of those made in the present pattern, and at a moderate expense. As the adoption of breech-loaders will require a modification of cartridge boxes, it is recommended that the two operations should be simultaneous.

In presenting this report before the final trials and decision as to the best model for conversion of muzzle-loaders, the Board is constrained by the approaching adjournment of the Legislature, before whom it may be deemed necessary to bring the whole subject, in order to secure the necessary appropriations.

GEO. W. PALMER,
Com.-Gen. of Ord. S. N. Y.

W. G. WARD,
Brig.-Gen. N. G. S. N. Y.

GEO. M. BAKER,
Col. Comd'g 74th Regt. N. G. S. N. Y.

SILAS W. BURT,
Col. and Asst. Inspector-Gen. S. N. Y.

GENERAL HEAD-QUARTERS, STATE OF NEW YORK,
 ADJUTANT-GENERAL'S OFFICE,
 ALBANY, *May* 18th, 1867. }

SPECIAL ORDERS }
 No. 126. }

The Board of Officers directed by Special Orders No. 2, current series, to make an examination of breech-loading small arms, having recommended a further test of the Allin, the Berdan, and the Roberts methods of conversion of muzzle-loaders, the Board is hereby directed to make such further examination and trial of the above named arms as may be deemed proper, to determine the best method of conversion.

The Board is also authorized to admit to such trial such other arms as upon exhibition to it may appear to possess sufficient merit to entitle them to competition, upon the same terms, and subject to the same conditions as the arms above named; and will make report of its proceedings and decisions to these Head-Quarters.

By order of the Commander-in-Chief,

S. E. MARVIN,
Adjutant-General.

SUPPLEMENTARY REPORT

OF THE

BOARD FOR EXAMINATION

OF

Breech-Loading Military Small Arms.

STATE OF NEW YORK.

Respects of Elden E. Haro
Adjutant General of the S.
_____ of New York

ALBANY:

WEED, PARSONS AND COMPANY, PRINTERS.

1868.



REPORT.

NEW YORK STATE ARSENAL, }
NEW YORK CITY, January 30, 1868. }

To Brigadier-General S. E. MARVIN,
Adjutant-General, Albany, N. Y. :

The Board of Officers, convened by Special Orders No. 2, and reassembled by Special Orders No. 126, both of series of 1867, makes the following

R E P O R T,

in accordance with orders, as follows :

GENERAL HEAD-QUARTERS, STATE OF NEW YORK, }
ADJUTANT-GENERAL'S OFFICE, }
ALBANY, *May* 18, 1867. }

Special Orders, }
No. 126. }

The Board of Officers directed by Special Orders No. 2, current series, to make an examination of breech-loading small arms, having recommended a further test of the Allin, the Berdan and the Roberts methods of conversion of muzzle-loaders, the Board is directed to make such further examination and trial of the above named arms as may be deemed proper to determine the best method of conversion.

The Board is also authorized to admit to such trial such other arms, as upon exhibition to it, may appear to possess sufficient merit to entitle them to competition, upon the same terms and subject to the same conditions as the arms above named, and will make report of its proceedings and decision to these Head-Quarters.

By order of the Commander-in-Chief,

(Signed) S. E. MARVIN, *Adjutant-General*.

The Board having previously experienced great difficulty in a proper relative estimation of the action of the several arms on account of differences of ammunition used in each, and being further desirous of establishing common conditions, applicable to all competitors and binding upon them, published the following programme :

Conversion of Muzzle-Loading Small Arms into Breech-Loaders.

NEW YORK, *June 5th*, 1867.

In accordance with the following orders —

[Special Orders No. 126, as above],

the Board of Examination hereby gives notice that it will proceed to make competitive trials of methods of conversion, at the State Arsenal, 7th Avenue, corner of 35th street, on July 9th next, at ten o'clock A. M.

All arms presented, other than of the three methods specially mentioned in the above orders (whether the same are improvements of arms hitherto tested by the Board, or arms not so tested), will be examined by the Board, and if, in its opinion, possessing sufficient merit to entitle them to competition, will be accepted for trial upon the same conditions as the above-named arms.

The following conditions of entry have been adopted, and all arms accepted will be subject thereto :

I. The arm must be a Springfield Rifled Musket, converted into a breech-loader, the barrel to be of the calibre .58. Additional guns of the same class, with calibre reduced to .50, may be exhibited, and will be tested at the discretion of the Board. Alleged improvements in rifling (number, depth and width of grooves, character of twist, &c.), will be considered.

II. Each gun must be accompanied with a full and detailed description of the arm and its merits, giving dimensions of the principal parts, as (A) length of barrel, or distance from muzzle to face of breech-block, when breech is closed; (B) length and diameter of chamber, and, if the chamber is conical, the maximum and minimum diameters; (C) dimensions of receiver, breech-block and appendages, retractor, and all other parts connected with the breech mechanism. The material of which the several parts are made must be specified; also, whether the specimen arm was made by hand or machinery. The description must be full and accurate, and must specially set forth the merits, absolute and relative, claimed for the arm. The cost of converting Springfield Rifled Muskets on the proposed plan must be given, the quantities being 10,000, 20,000, 30,000, 40,000 and 50,000, and the exhibitor must be prepared, upon demand, to furnish an undertaking, with approved sureties, that contracts will be made at the rates specified should the method of conversion be approved and the State authorities prepared to entertain proposals. Such prices will be considered as sealed proposals, and will not be disclosed until after a decision is made by the Board.

III. In order that the several arms may be subjected to the same conditions of trial, each exhibitor must be supplied with fifteen hundred (1,500) rounds of ammunition for each arm, as follows: The cartridge cases to be of brass and "central fire." The projectiles to be of unalloyed lead, and to weigh four hundred and eighty grains for guns of calibre .58, and four hundred and fifty grains for calibre .50. In order to

conform to the United States standard charge, as now adopted, the charge of powder will be seventy grains. The powder to be the "Orange Rifle Powder, F. G.," manufactured by Smith & Rand (office 170 Broadway, New York City). Particular attention is directed to the proper lubrication of the cartridges. In special tests, the Board reserves the right to use such other quality of powder as it may deem proper, but not exceeding the established charge of seventy grains; and also the right to use such form of projectiles as may be deemed proper.

IV. The several guns accepted for competition will be subjected to exactly the same tests, and no other, except upon unanimous consent of the competitors and approval of the Board. The arms, after entry and acceptance, will remain in the exclusive charge and control of the Board, and, except with its consent, shall not be withdrawn.

V. The guns will be subjected to the following tests :

1st. For endurance—to be tested with one thousand (1,000) rounds, in series of one hundred rounds each, discharged rapidly, the arm to be cooled, cleaned and inspected in the intervals, and the *wear and tear*, absolute and relative, carefully noted.

2d. To be fired fifty rounds with ammunition prepared by the Board.

3d. To be fired with defective cartridges such number of times as the Board may deem necessary.

4th. The Board reserves the right to subject all the arms to such other practical trials as may be deemed necessary to fully test their merits.

VI. Each exhibitor will be required to execute an agreement to submit his arms to the tests and conditions herein set forth.

Entries of arms may be made at any time, prior to July 8th,

with Col. SILAS W. BURT, Assistant Inspector-General, 46 University Place, New-York City.

GEORGE W. PALMER,

Brig. Gen'l & Comm'y Gen'l of Ordnance.

WILLIAM G. WARD,

Brig. Gen'l Command'g 1st Brigade, N. G.

GEORGE M. BAKER,

Col. Commanding 74th Regiment, N. G.

SILAS W. BURT,

Colonel & Assistant Inspector-General.

The Board convened on the 9th day of July, and continued its sessions on the 10th, 11th, 12th, 15th, 16th, 17th, 18th, 19th, 23d, 24th, 29th, 30th and 31st days of that month; the 17th, 18th, 19th, 20th, 21st, 23d and 24th of September; the 2d, 3d, 4th and 5th of October; the 20th of November, and the 10th and 11th of December.

The guns presented for competition embraced the best systems invented, and the Board is convinced that all practicable methods of breech-block movement have been already applied, and that future efforts in this direction must be confined to details or combinations. Including both sessions of the Board, thirty-six distinct systems have been tested and seven others examined, and as these have comprehended every general principle applied in this country or abroad, the Board feels confidence in expressing the opinion, that no radical improvement over present systems is probable, and that future advance must be made in the direction of improved ammunition, or by a complete abandonment of present armaments and a sub-

stitution of entirely novel weapons of warfare. Our own great recent war, and the hostile complications in Europe, have stimulated and directed into this channel the inventive skill of both continents, and thus produced a rapid development.

The arms tested at this session were, the Allin, the Berdan No. 2, the Roberts, the Allin, cal. .50, the Berdan No. 1, the Lamson, cal. .58 and .50, the Miller, the Needham, the Conroy, the Remington and the Burton. Several other guns were exhibited, as noted beyond.

The tests were applied as in the programme, except that in the second test, the fifty rounds of prepared ammunition were reduced to four rounds of seventy grains each of Orange Lightning Powder and four hundred and eighty grains of lead. The tests with this strong powder being applied immediately after the first test of one thousand rounds, it was concluded that four charges, fired successively and rapidly, would demonstrate any weakness as certainly as the greater number.

In the first test the guns were cooled as rapidly as practicable after each round of one hundred discharges, the barrels cleaned, and the firing recommenced without delay.

The prescription of the ammunition by the Board somewhat embarrassed exhibitors, as it could be procured at only one factory, and there the sudden demand soon exhausted the supply of seasoned cartridges, and exhibitors were forced to take those in which the fulminate was, in some cases, damp, and frequent misfires were the result. The cartridges were the Berdan, as described in the previous report.

The guns are classified in accordance with the method adopted in the report of April 6th, last.

Guns Specially Designated for Trial in the First Clause of
the Orders.

CLASS FIRST.

THE ALLIN BREECH-LOADER,

Entered by the Allin Patent Fire-Arms Manufacturing Company
New York City.

DESCRIPTION.

The rear upper part of the barrel is first cut away, forming an opening for the breech-block to be inserted, three and one-fourth inches in length. The *Breech-block* consists of a solid piece of iron (case-hardened) which fills up the portion of the barrel cut away, as well as the bore of the same, and is hinged at its front end to a piece called the hinge-strap, firmly attached to the barrel over the rear end of the bore where the cartridge is inserted. When the cartridge is to be inserted the breech-block is swung upwards and forward, exposing the end of the bore, which is formed into a chamber sufficiently large to allow the shell of a metallic cartridge of the proper calibre to be inserted. The device for locking the breech-block at its rear end

consists of a solid steel cam and shaft, the latter of which projects out at the side, through a cut formed in the barrel in the place of the cone-seat. To the projecting end of the shaft is attached a lever or thumb-piece, which operates the cam, so that by placing the thumb on the lever and turning it back, the end of the cam enters a notch formed in the breech-pin made to receive it; and by turning up and forward this lever, the cam is withdrawn from the notch and the breech-block is free to be raised. The cartridge is exploded by a blow from the hammer, arranged as ordinarily, the force of the blow being received, however, through the medium of a firing-pin, arranged in the upper part of the breech-block, resting upon the rear end of the cartridge, and the rear end projecting out from the rear end of the breech-block, to receive the blow from the hammer.

In order to prevent the possibility of the hammer falling upon the firing-pin when the breech-block is not down and locked, a projection is arranged upon the end of the lever or thumb-piece, operating the cam-lock, in such a manner that when the lever is entirely up the hammer shall strike this projection and be prevented from reaching the firing-pin; and when the lever is partially down the nose of the hammer shall strike on this projection, forcing the lever down entirely and locking the breech-block. For the purpose of preventing the hammer from striking the firing-pin before the breech-block is down entirely, a projection is arranged on the rear end of the breech-block, just beneath the end of the firing-pin, and upon this projection the hammer would strike in such an instance.

A latch-spring is so arranged under the cam-lock, that by closing down the breech-block in place it locks itself. The front end of the breech-block, forming when shut the rear end of the cartridge chamber, is slightly beveled so as to project forward at its lower part, and the end of the barrel at this part is formed to correspond to it; thus the breech-block is held firmly in place when shut, even though the hinge should be broken, as no strain is produced upon the hinge in firing.

An extractor for the cartridge case is formed by extending a small projection on the breech-block in front of the hinge, so that when the breech-block is raised and thrown forward, this projection passing through a groove formed for it, catches in front of the rim of the shell, at the top or upper side, and starts it back, leaving the ejector (if such be used) to throw it out. When the breech-block is down the projection is thrown up above the line of the bore, and does not interfere with the cartridge case. The method of ejecting the case entirely from the barrel is as follows, viz: A lever is inserted across the breech-block in rear of the hinge in a groove (secured by a screw), in such a manner that when the breech-block is turned upward and forward so far that the ejector will start the shell, a sudden blow will be given to the ejector, having a projection on the upper side, by the breech-block upon the end of the lever, which gives the ejector, consequently, an accelerated motion sufficient to expel the shell from the barrel.

TESTS.

First Test.—1st Round — 100 fires and 22 misfires.

This large proportion of misfires was attributable to the use of an experimental cartridge, which was disapproved by the Board.

2d Round — 100 fires and no misfires.

3d “ 100 “ “

4th “ 100 “ “

5th “ 100 “ “

6th “ 100 fires and 2 misfires.

7th “ 100 fires and no misfires.

8th “ 100 “ “

One cartridge case split at base and sides, and one split in the side; the gas, thus escaping, fouled the receiver and block, but not otherwise affecting the piece.

9th Round — 100 fires and no misfires.

One cartridge case split at base and sides.

10th Round — 100 fires and 1 misfire.

The gun operated well during this test, and no wear of the working parts, except a slight battering of the ejector, nor any derangement of any part, was perceptible at the close.

Second Test.—Four cartridges of 70 grains “ Lightning ” Powder, fired without affecting the arm.

Third Test.—Four cartridges, the heads being well filed all around, were fired without starting the breech-block or otherwise deranging the mechanism. A cartridge filed two-thirds around was fired with similar result.

THE BERDAN BREECH-LOADING RIFLE, No. 2.

Entered by the Berdan Arms Manufacturing Co., New York City.

DESCRIPTION.

The exhibitor not having furnished any detailed dimensions, &c., as required by paragraph two of the

programme, reference is made to the description of this gun given in the report made April 6th last (page 13), as no material change has been made in the meantime.

TESTS.

First Test.—1st Round — 100 fires and no misfires.

2d	"	100	"	"	"
3d	"	100	"	1	"
4th	"	100	"	no	"
5th	"	100	"	7	"
6th	"	100	"	3	"
7th	"	100	"	2	"
8th	"	100	"	2	"
9th	"	100	"	2	"
10th	"	100	"	5	"

The gun worked well. The intervals between the rounds were short, the gun being cooled by passing a stream of cold water through the barrel. No appreciable wear of working parts or derangement of mechanism.

Second Test.—Four "Lightning" cartridges were fired, with results entirely satisfactory.

Third Test.—Four cartridges fired, the heads of which were filed all around, and one cartridge with head filed two-thirds around, without affecting the working of the gun or deranging it in any way.

CLASS THIRD.

THE ROBERTS BREECH-LOADING RIFLE,

Entered by the Roberts Breech-Loading Arms Co., New York City.

DESCRIPTION.

Calibre, .58 inch; distance from muzzle to face of breech-block, when closed, 37 inches; length of cham-

ber, 1.25 inch. The chamber has a uniform taper for its entire length; maximum diameter, .64 inch; minimum diameter, .58 inch. Receiver, 2 inches in length; breech-block, .75 inch wide. Breech-block and all its appendages assembled from one piece 5 inches in length.

The musket presented is of the United States "Springfield" pattern, made by machinery. The breech-loading parts, five in number, were made by hand, and constitute "the Roberts breech-loading attachment." The first piece is an iron breech-frame or receiver, into which the barrel, having been cut off at proper point, is firmly screwed. This receiver is imbedded in the stock in the place of the old breech-pin. The barrel is cut off about one inch in front of the cone, and a male screw cut, reaching nearly to the rear sight on the barrel. The breech-block is inserted through this receiver, and supported against the rear end on a semi-circular shoulder, forming the back of receiver, the centre around which this semi-circle is described being in the prolongation of the axis of the barrel. The rear of the breech-block is turned to fit with exactness this semi-circle, and is played around it as a fulcrum. The cheeks of the receiver support the breech-block laterally. When the breech-block is in place in the receiver, it forms a curved lever, the handle projecting backward, and it then is moved about the solid abutment of the receiver, instead of being pivoted by any system of points or pins, thus affording great solidity and strength.

The forward end of the breech-block has a semi-circular groove cut transversely through it, for the purpose of receiving a corresponding tenon formed on

a block of steel, termed the recoil-plate. The front face of this block is flat, so that when in position it fits squarely against the vertical face of the chamber and the rear end of the cartridge case. A small space is left between the tenon on the rear of this block and the front surface of the breech-block above the transverse groove, to admit of a slight rocking motion of recoil-plate, so that it will descend to expose the breech of the barrel and admit the cartridge into the chamber. This small open space permits the recoil-plate to descend perpendicularly, when the rear of the lever is raised until the top of the plate passes below the axis of the barrel, after which it swings with the arc of the circle on the rear end of the receiver. When the rear of the lever is raised, the recoil-plate ascends to its position by the exact reverse motion, up to the axis of the barrel on a circular motion and afterward to close the chamber, ascending vertically and closing squarely against the head of the cartridge case and the vertical face of the chamber.

The firing-pin is located on the right side of the breech-block, and runs through both this block and the recoil-plate, directed to the center for center-fire cartridges, and grooved into the sides for rim-fire cartridges. It is so set on a shoulder that the force of the blow of the hammer cannot drive it a greater distance than is necessary to insure fire.

The retractor is a curved lever, fixed on the left side of the chamber, with one arm behind the flange of the cartridge-case, and the other operating in a vertical groove on the left side of the recoil-plate. When the breech-lever is raised and the recoil-plate descends,

the arm in the groove is not touched until the top of this plate reaches the bottom of the chamber; the shoulder at the upper end of the groove then strikes the lever and ejects the cartridge case.

TESTS.

First Test.—1st Round — 100 fires and 5 misfires.

2d	"	100	"	4	"
3d	"	100	"	4	"
4th	"	100	"	8	"
5th	"	100	"	3	"

During the last round it was noticed that the firing-pin was broken, occasioned by a flaw in the metal, and had been apparently broken during the most of this round. As the gun continued to operate well, the exhibitors concluded to continue firing without repairing the pin, and permission so to do was granted by the Board.

6th Round — 100 fires and 10 misfires.

7th	"	100	"	6	"
8th	"	100	"	1	"
9th	"	100	"	1	"
10th	"	100	"	1	"

The gun withstood this test well, no wear or derangement of the mechanism being apparent, except the broken firing-pin, which was attributable to defective metal, as was manifest by the appearance of the fracture.

Second Test.—Four cartridges of 70 grains "Lightning" powder and 480 grains of lead, were successively fired, without affecting the gun.

Third Test.—Fired one cartridge with head filed all around; mechanism not affected, except the broken firing-pin driven forward so as to render opening of breech difficult. By permission, a new pin was substituted, and four cartridges with heads filed all around, and one cartridge with head filed two-thirds around, were fired, without in any way affecting the breech-block or deranging the mechanism of the gun.

Guns entered under provisions of second clause of Special Orders.

“The Board is also authorized to admit to such trial such other arms, as upon exhibition to it, may appear to possess sufficient merit to entitle them to competition, upon the same terms and subject to the same conditions as the above named.”

In accordance with the above provision, and also with the following clause in paragraph I, of the published programme of trials: “Additional guns of the same class, with calibre reduced to .50, may be exhibited, and will be tested at the discretion of the Board,” the following guns were admitted to competition and tested by the Board:

CLASS FIRST.

THE ALLIN BREECH-LOADER, CALIBRE .50.

Entered by the Allin Patent Arms-Manufacturing Co., New York City.

DESCRIPTION.

The breech-mechanism and appendages of this arm are the same as those of the .58 calibre gun, on the same system previously described. The barrel originally of .58 calibre is reduced to .50, by the following process:

The barrel is first bored out to remove the *lands*, if it be a rifled barrel, leaving it of the desired decrease inside from breach to muzzle. Into this is forced a tube of iron or steel, which is also made with a taper

to suit the seat formed for it in the barrel. This *reinforce*, so placed by being forcibly driven in, is firmly fastened there as follows: A slot is cut through the outside tube to the surface of the inner one; both are then heated and brass wire inserted in the slot, borax being used as a flux. The wire melting, the fluid brass runs in between the two tubes, filling up the imperceptible space between them in the vicinity of the slot, for the distance of two or three inches. (These brazings may be repeated throughout the length of the barrel, but are not necessary.) The brazing at the muzzle is effected by placing a ring of brass wire, well fluxed, around the extended end of the inner tube, the barrel being placed in a vertical position, the wire is then heated to the melting point, when it penetrates between the two tubes. Each end of the barrel being thus *firmly* brazed, forms a solid barrel; it is then bored and rifled in the usual manner.

The following are some of the principal dimensions of the .50 calibre Allin gun: Length of barrel from muzzle to face of breech-block, 36 5-8 inches; length of chamber, 1.76; diameters of chamber, maximum .57 inch, minimum .54 inch; iron breech-block, length 3.25 inches; iron breech-block cap, length .87 inch; width of receiver .7 inch; length of iron hinge-strap, 2 inches; locking device, steel cam-latch, length .62 inch; shaft, length 1.5 inch; iron thumb-piece, length 1.37 inch; steel firing-pin, 3.12 inches in length.

TESTS.

First Test.—First round—100 fires and no misfires. Upon the 78th discharge the back sight (soldered to the barrel) was detached by melting of the solder.

2d	Round	—	100	fires	and	1	misfire.
3d	"		100	"	no	"	
4th	"		100	"		"	
5th	"		68	"		"	

Upon the 68th discharge the breech was blown open so violently as to bend up the rear portion of the hinge-strap, partially tearing it in two, and deranging the parts so that the breech could not be closed. The eartridge-case was driven back violently against the rear of receiver and thrown out, but not burst, though deformed. The person firing the gun was not in any way injured. After careful examination, it was discovered that the screw which retains the firing-pin in position had been turned out, so as to allow the pin to project backward 1-32 of an inch beyond its proper position, and so that the thumb piece of the breech-lock would, in revolving, strike the pin. In the hurry of rapid firing, the breech was not entirely closed when the trigger was pulled, and the hammer striking the thumb-piece, drove it against the firing-pin, thus exploding the cartridge before the breech was closed.

Liability to such accident has since been obviated by a change in the manner of securing the firing-pin, not readily deranged, and by lengthening the lever of breech-lock, so that, under no circumstances, can it strike the firing-pin.

The gun, being disabled as above, was, by permission of the Board, withdrawn, and not again presented, as the exhibitors substituted the .58 calibre gun described on a previous page.

BERDAN'S BREECH-LOADING RIFLE, No. 1.

Entered by the Berdan Arms-Manufacturing Co., New York City.

DESCRIPTION.

The exhibitors not having complied with paragraph II of the programme, no detailed description will be given. Col. Berdan calls it a "jointed breech-piece"

gun, and in its general features it resembles the Allin gun, being provided with an independent locking device, as recommended in the previous report of the Board. The workmanship of the gun was very fine and noticeable.

TESTS.

First Test.—1st Round—100 fires and no misfires.

2d	"	100	"	4	"
3d	"	100	"	no	"
4th	"	100	"	no	"
5th	"	100	"	2	"
6th	"	100	"	5	"
7th	"	100	"	2	"
8th	"	100	"	8	"
9th	"	100	"	5	"
10th	"	100	"	8	"

The gun worked well during this test; the mechanism not being in any way deranged, nor any appreciable wear.

Second Test.—Four of the "Lightning" cartridges fired without affecting the gun.

Third Test.—Four cartridges with the heads filed all around and one filed two-thirds around fired without deranging the gun. Afterwards fired two similar cartridges, the thumb piece of breech-lock lever being cut off, to demonstrate that hammer does not assist in the efficient locking of the breach—results satisfactory.

THE LAMSON BREECH-LOADING RIFLE (CAL. .50).

Entered by the Windsor Manufacturing Co., Windsor, Vt.

DESCRIPTION.

This gun is in all respects similar to the gun of same system and calibre .58, described beyond, except in

having a barrel reinforced or reduced in calibre to .50, as described previously.

TESTS.

First Test.—1st round—100 fires and 21 misfires. The cartridges were very imperfect, and the fulminate evidently damp.

2d Round — 100 fires and 7 misfires.

3d	"	100	"	11	"
4th	"	100	"	12	"
5th	"	100	"	13	"
6th	"	100	"	25	"
7th	"	100	"	26	"
8th	"	100	"	22	"
9th	"	100	"	19	"
10th	"	100	"	21	"

The gun worked well, without perceptible wear or derangement of any part.

Second Test.—Tried four "Lightning" cartridges with results entirely satisfactory.

Third Test.—Fired one cartridge with head filed all around, blowing open the breech-block one and a half inch, but the gun not in any way disabled. The exhibitor claimed that this result was occasioned by neglect to plug the old cone-vent, the Board ordered this to be done, and when completed, and a cartridge with head filed all around being fired, the breech-block was blown open one and three-quarters inch. Two similar cartridges were then fired and breech blown open two inches each time. The gun was apparently not otherwise affected by these results. A cartridge with head filed half way around was then placed in the chamber with filed portion down and fired, the breech-block was blown open .13 inch. After carefully cleaning the gun, three perfect cartridges were fired without opening the breech, and the gun appeared to be in as good working order as when first presented. Then fired a cartridge with head filed one-third around, and breech-block was blown open .17 inch. Without cleaning, two perfect cartridges were fired, and then one with substitution of "Lightning" powder, the breech remaining closed and the gun otherwise working well.

By permission the gun was withdrawn, and again presented with certain modifications, greater space around the sides of the breech-block being allowed for escape of gas, and the hammer having a more secure hook upon the projecting lip of the breech-block. Two cartridges with heads filed all around were fired without opening the breech or otherwise affecting the gun. The Board considered this test sufficient as the principles involved were to be more fully tested in the .58 calibre gun of same system.

THE LAMSON BREECH-LOADING RIFLE (CAL. .58).

Entered by the Windsor Manufacturing Co., Windsor, Vt.

DESCRIPTION.

The breech receiver is formed by cutting away the upper part of the barrel immediately in front of the breech-pin. The breech system is composed of nine pieces, viz: the carrier-block, the sliding breech-block, the firing-pin, the firing-pin screw, the ejector, the ejector spring, the hinge-band, the joint-screw and the spring-screw. Length of barrel from muzzle to rear of chamber, 37 inches; calibre of bore, .58 inch; diameters of chamber, maximum .65 inch and minimum .62 inch; length of chamber, 1.76 inch. The mean dimensions of the carrier-block, are 3 inches by 1.09 inch by .42 inch, and of the breech-block, 2.43 inches by .7 inch by .48 and .75 inch. Length of hinge-band 2.06 inches and thickness outside of barrel .07 inch; width of hinge, 1.1 inch; of spring slot, .56 inch, and of the spring, .55, with average thickness of .05 inch. The ejector, .13 inch thick, and greatest length .8 inch. Length of firing-pin, 3.37 inches, with body diameter of .21 inch and .08 at point.

Since previously exhibited to the Board in January, 1867, marked modifications have been made in this gun. The previous attachment of breech-block hinge to the barrell by a strap or sadde, has been changed to a band, clasping the barrel and reinforcing at a desirable point. The breech-block now enters the chamber like a stopple. The peculiarity of this gun, as compared with others of its class, is in the division of the breech-block into the carrier-block, and the breech-block proper, sliding longitudinally on each other. The breech-block has two motions relative to the cartridge-chamber, a longitudinal slide and a lateral motion at the forward end, to allow it, when entering the chamber, to follow the straight line of the bore, as otherwise it would continue to describe the arc of a circle, whose centre would be that of the hinge screw. By these combined movements, it is claimed that the breech-block is well inserted in the chamber, fitting closely the mouth thereof; that compensatory movement is allowed for variations in the thickness of cartridge-case heads; that the rear end of the block, when cartridge is inserted, rests firmly in the recoil-seat, cut perpendicularly to the axis of the bore, and in the stable-breech of the gun, preventing it from upsetting by recoil, and removing all strain from the hinge of the carrier-block. To prevent the carrier-block from uprising in case of bursting of cartridge-case, the forward end is secured by entry into the cartridge-chamber, while it is firmly locked down in the rear by the double friction concave and convex surfaces, respectively described by the one and the co-ordinate center on which the hammer swings; the swing of the

carrier-block being different therefrom. The retractor rotates upon the hinge-pin of the carrier-block, and gradually draws the case till entirely loose, when a suddenly accelerated motion is given by means of spring, and ejecting the case entirely from the chamber. One of these ejector-springs, snapped at the rate of two hundred and eighty times per minute, endured till the 27,160th "snap" before fracture. The firing-pin operates in the usual manner, and the hammer, when down, locks over a projecting lip on the rear of the carrier-block, thus securing the breech from accidental opening.

The cartridges used with this gun were carefully charged at Windsor, and lubricated by Ball's patent machine, and form a good illustration of careful preparation and manufacture.

TESTS.

First Test.—1st Round — 100 fires and no misfires.

2d	"	100	"	"
3d	"	100	"	"
4th	"	100	"	"
5th	"	100	"	"
6th	"	100	"	"
7th	"	100	"	"
8th	"	100	"	"
9th	"	100	"	"
10th	"	100	"	1 "

This test was entirely satisfactory.

Second Test.—Four cartridges of "Lightning" powder fired without affecting the gun.

Third Test.—Four cartridges with heads filed all around and one with the head filed two-thirds around, were fired without opening the breech or deranging the gun. It was apparent that the hammer held the breech-block down.

THE MILLER CONVERTED BREECH-LOADER.

Entered by W. H. & G. W. Miller, West Meriden, Ct.

DESCRIPTION.

This gun resembles very closely the Allin gun, being claimed as an improvement thereon, by means of a new locking device for the breech-block. The breech receiver is formed by cutting away the upper part of barrel in usual manner. Length of barrel from end of breech-block, 37 inches; length of chamber, 1.5, with maximum diameter of .65 and minimum of .63 inch. Diameter of receiver, .76, and length 2.5 inches. The breech-block is made with a round solid plug fitting the receiver, with flanges projecting over the top even with the outside of the barrel. (This tight fit was modified during trial—see 3d test.) The block is hinged at forward end in usual manner, and at its rear end in a vertical slot is fitted the sliding bolt which locks the breech when closed; this bolt, or more properly, “key,” has a bearing against the breech-pin .5 inch by .37 inch, and a sliding motion of about .2 inch. It is manipulated by a shaft, lever, and thumb-piece, very similar to those parts in the Allin gun. The retractor is the same as that used in the latter gun, reference to which (page 11) is made for description.

TESTS.

First Test.—1st round—100 fires and no misfires.

At the close of this round a flaw was discovered in the breech-block, extending across the hinge, and occasioned by an imperfect weld, and by permission the gun was withdrawn for the

substitution of perfect parts. Upon the gun being returned it was concluded to recommence this test.

1st Round — 100 fires and 5 misfires.

2d	"	100	"	4	"
3d	"	100	"	2	"
4th	"	100	"	6	"
5th	"	100	"	5	"
6th	"	100	"	7	"
7th	"	100	"	4	"
8th	"	100	"	3	"
9th	"	100	"	no	"
10th	"	100	"	"	"

The cartridges (external primers) used in the first six rounds leaked about the cap orifice, and fouled the chamber very much. The gun worked well, and the test was satisfactory.

Second Test.—Four "Lightning" cartridges were fired without affecting the gun.

Third Test.—Fired a cartridge with head filed all around; the breech-block was blown open and the hammer cocked by the explosion; the tumbler of the lock was also broken, but no other appreciable injury. A new tumbler having been placed in the lock, a similar cartridge was fired, and the breech was again blown open, the hammer remaining down, but the key or bolt of the locking device was broken into two pieces. Permission being granted, the gun was repaired by a substitution of a new key, and the breech-block, the close fit of which in the receiver had been considered an advantage by the exhibitors, was cut away on the sides to allow a free escape of gas. No other changes were made. It was then fired with four cartridges, the heads of which were filed all around, and one filed two-thirds around, without affecting the breech or appendages.

THE NEEDHAM BREECH-LOADER.

Entered by James Graham Gray, New York City.

DESCRIPTION.

The barrel of original gun is cut off about three inches in front of the breech-pin, and screwed into a new breech-receiver. The breech-block consists of a solid piece of iron hinged to the front of receiver, and moving in a horizontal plane to the right in opening the breech. The original lock is retained, but the hammer is prolonged into a wedge-formed key, which, in firing, descends into a vertical slot, cut into the rear of the breech-block, thus locking it in place, and at the same time the wedge drives forward the firing-pin. To open the breech, the hammer is cocked, thus releasing the block, which is, however, retained in place by the back pressure of the firing-pin acted upon by a spiral spring. By a projecting handle on upper and back part of the block, it is swung laterally and forward, and strikes a spur attached to the extractor, working on the same hinge, and thus drawing out the cartridge-case. Length of barrel, 37 inches; length of chamber, 3 inches; length of breech-receiver, 4 inches, with width of 1.25 inch.

TESTS.

The Board, after a careful examination of this gun as first presented, being of opinion that the locking device would not withstand the third test, concluded to save time by such a trial at the outset. Four cartridges with heads filed all around were consecutively fired, and the breech was on each occasion blown open, the hammer being partially thrown up and the projecting wedge bent. The exhibitor claiming that this result was occasioned by

a defect in the workmanship and not in the principle, permission was granted him to withdraw the gun and changes to be made. This being done, the gun was again presented, and withstanding the successive action of three filed cartridges, was admitted to the regular routine of trial.

First Test.—1st Round — 100 fires and 1 misfire.

2d	"	100	"	5	"
3d	"	100	"	6	"
4th	"	100	"	6	"
5th	"	100	"	6	"
6th	"	100	"	3	"
7th	"	100	"	3	"
8th	"	100	"	10	"
9th	"	100	"	22	"
10th	"	100	"	22	"

The large proportion of the misfires in the last two rounds is attributable to the imperfect system of driving the firing-pin. This being done by the wedge motion of the prolonged hammer, is confined to a motion of less than one tenth of an inch, and indirect, *i. e.*, not the direct full blow from the hammer ordinarily received, and consequently readily affected by gradual loosening and play of the hammer or *debility* of the spring. The cartridges that missed fire were successfully exploded in another kind of gun.

Second Test.—Four "Lightning" cartridges were fired, with perceptible effect upon the gun.

Third Test.—Fired four cartridges with heads filed all around and one with head filed two-thirds around, without blowing open the breech or deranging the gun, though the strain upon the hammer was very perceptible.

CLASS FOURTH.

THE CONROY BREECH-LOADER.

Entered by General E. L. Molineux, New York City.

DESCRIPTION.

This gun has a separate breech-receiver into which the barrel is screwed. The receiver, breech-block, hammer, trigger, guard lever and recoil block are of wrought iron case-hardened. The lock spring and retractors are of steel. Length of barrel $37\frac{3}{4}$ inches. Distance from centre of butt-plate to face of breech-block $14\frac{3}{4}$ inches. Calibre of barrel .58 inch.

The breech-block is a quarter of a circle, whose radius is 1.75 inches, and it has a thickness of .81 inch. Through the center of the block is an opening, into which the hammer is fitted; in the lower end of the hammer there is a suitable slot to receive the upper portion of the trigger, which portion is cone-shaped. The guard lever has a pair of lugs on its forward end, and enters up into the walls of the receiver which is formed to receive them. Through the lower portion of the receiver, and in line with the face of the breech-block when closed, there is a hole to receive the pin, which passes through the center of revolution of the breech-block, the hammer and the trigger, thus these three pieces swing on a common center. In connection with this pin is a sleeve, serving a double purpose; before the parts are placed in the receiver, they are placed in position and the sleeve passed through them, thus securing their centers, so that when placed in the receiver the passage of the pin is facilitated; it also

reduces friction. The main spring is placed forward and beneath, nearly in line with the center pin, the upper limb of which serves as a stop when the hammer is cocked. By pulling on the trigger the upper limb of the spring is raised by the action of the cam, and the hammer being liberated is brought down by the lower portion of the main-spring, which has been previously kept in tension by the cocking of the hammer. The recoil block is a short piece of the same thickness as breech-block, its rear end is semi-circular, and it rests in a corresponding seat in the upper and rear end of the receiver, and is kept in position by a pivotal pin. The forward end of this block is fitted against a shoulder formed in the breech-block, and which thus braced transmits the recoil in a direct line to the recoil seat. In bringing down the guard lever, its first operation is to raise the recoil block sufficiently (and no more) to release the breech block, which then revolves, its movement being accelerated by a spring. The retractor may be single or double: in the gun presented it was double, having a positive motion and operated by the guard lever.

TESTS.

First Test.—1st Round — 100 fires and 5 misfires.

2d	"	100	"	4	"
3d	"	100	"	9	"
4th	"	100	"	5	"
5th	"	100	"	3	"
6th	"	100	"	9	"
7th	"	100	"	4	"
8th	"	100	"	9	"
9th	"	100	"	9	"
10th	"	100	"	6	"

The gun withstood this test without any perceptible wear of the working parts or their derangement.

Second Test. Fired four "Lightning" cartridges without affecting the gun.

Third Test. Fired four cartridges with the heads filed all around, and one with head filed two-thirds around. The breech remained stable and the mechanism unaffected.

As this gun had not been examined at the previous session of the Board, it was submitted to several of the tests at that time prescribed (See pages 6 and 7, Report of April 6.)

For *rapidity* it was fired at a target $15\frac{1}{4}$ inches in diameter, at range of one hundred feet, thirteen times in a minute, by Mr. Conroy, three balls entering the target. It was then fired by Mr. A. G. Sinclair sixteen times in a minute, five balls in target; seventeen times in a minute and two balls in target; and fifteen times in a minute and eleven balls in target.

It was then subjected to the "sand-test" (No. 9 of previous report), and was readily cleansed by percussion and wiping with the fingers. This test repeated with same result and the gun was fired several times, operating satisfactorily.

THE REMINGTON IMPROVED BREECH-LOADER.

Entered by E. Remington & Sons, Ilion, N. Y.

DESCRIPTION.

This is an adaptation of the "Remington breech-system" to the Springfield Rifle Musket. The *system* is manufactured by machinery, and is the same in all essential respects as used in the original gun tested by the Board at its former session (page 45 of Report). The parts, material, and dimensions of the *system* are as follows :

Receiver, iron, case-hardened; length through the body at center, 4.25 inches; the thickness from out-

side to outside, 1.32 inch; thickness of sides, .29 inch. Guard-strap, iron, case-hardened; length, 8.25 inches. Breech-block, steel; thickness, .735 inch; body, .837 at face; diameter at axis, 1.04 inch. Hammer, steel; thickness, .735 inch; distance from recoil shoulder to center of axis, .92 inch. Two pivotal pins, steel; diameter, .42 inch. Retractor, steel; length, 1.16 inch. Mainspring, steel; simple curve. Friction lever, steel. Friction lever spring, steel. Trigger, trigger-spring, firing-pin, firing-pin spring, button and two small pins, all of steel. Eight screws and one small pin of iron, case-hardened.

The barrel of the Springfield gun is cut off in front of its old breech-pin, a screw cut on outside at breech so as to fit the Remington breech receiver. Outer edge at breech is beveled on under side so as to conform to that portion of breech-block swinging underneath the barrel; and in this respect the same as entirely new guns of this system. The chamber is conical, with length of 1.95 inch; maximum diameter, .67 inch, minimum diameter, .62 inch; depth of counter-bore, .09 inch, diameter .77 inch. Length of barrel from muzzle to face of breech-block, $39\frac{5}{16}$ inches, same as Springfield muzzle-loading gun. Outside of barrel is same as Springfield gun, with addition of a recoil stud for front stock; diameter at screw, .97 inch, and at bottom of thread .915 inch. The stock of the Springfield gun has a section removed at locality corresponding to the Remington system, eliminating part adapted to Springfield lock and leaving the stock in two parts, these being fitted to the breech-receiver and barrel precisely as in new guns of this system. Ram-rod secured by screwing into lug in breach receiver, and head milled for

easy withdrawal. All the other parts same as in unconverted gun. For further description of operation of this gun, reference is made to previous report, page 45.

TESTS.

First Test.—1st Round—100 fires and 3 misfires.

2d	"	100	"	2	"
3d	"	100	"	4	"
4th	"	100	"	no	"
5th	"	100	"	4	"
6th	"	100	"	no	"
7th	"	100	"	2	"
8th	"	100	"	1	"
9th	"	100	"	no	"
10th	"	100	"	1	"

The gun operated well, there being no perceptible wear of the working parts nor any derangement thereof.

Second Test. Fired four "Lightning" cartridges without any effect upon the gun.

Third Test. Fired four cartridges with heads filed all around and one with head filed two-thirds around, without in any manner deranging the mechanism or disturbing the breech.

CLASS FIFTH.

THE BURTON BREECH-LOADING RIFLE.

Entered by Bethel Burton, Brooklyn, N. Y.

DESCRIPTION.

The barrel is screwed into a breech-receiver which is cylindrical in form, being a tube, into the forward end of which the barrel is screwed as above, and the rear end furnished with a female screw of eight threads

to the inch, cut in sections. The breech-block is cylindrical and closely fits the receiver, and has at its rear end a screw cut to fit that in the receiver. The receiver has an oblong orifice cut through upper side immediately in front of the chamber, for insertion of the cartridge, and which orifice has a sliding cover to which is attached a foot half an inch in length, to which projection is screwed a steady pin which is made to enter a chamber in the breech-block; through this steady pin there passes a plunger for transmitting the blow to the cartridge. In the breech-block chamber is placed a thimble constituting the hammer and containing a spiral spring, the thimble serving to transmit the blow to the plunger, and also to protect the spring from coming in contact with the pin on the trigger, and prevents sand or dirt from entering the chamber when the block is drawn back. The block has longitudinal or L-shaped slot cut, and in the receiver there is also a corresponding hole made, through which passes a square pin, serving to guide the breech-block in and out of place, and retaining the spring coiled up till released by action of the trigger, which, pulling down the pin, allows the spring to force the thimble against the plunger; and by means of said pin, premature discharge is prevented, as the trigger is not disengaged till the breech-block is firmly screwed by giving it one-quarter of an entire revolution, by means of a projecting handle at its rear end.

The cartridge-case is retracted by means of a straight spring let in to the under side of the cover of receiver, and is kept in place by the coupling of the cover and breech-block, the cover supporting the spring against fracture by bursting of cartridge-head. A hook on

the end of this spring passes over the flange of the cartridge-case when the breech is closed, and when the block is drawn back, retracts the case. The pressure of the spiral spring against the plunger, forces the cartridge forward, and being retained by the hook of the spring-retractor, as soon as the block is drawn back rapidly, the case is thrown out of the receiver.

TESTS.

First Test.—1st Round—100 fires and no misfires.

2d	"	100	"	"
3d	"	100	"	"
4th	"	100	"	"
5th	"	100	"	"
6th	"	100	"	"
7th	"	100	"	"
8th	"	100	"	"
9th	"	100	"	"
10th	"	100	"	"

This test was entirely satisfactory, there being no perceptible wear or derangement.

Second Test.—Fired four "Lightning" cartridges, with results entirely satisfactory.

Third Test.—Fired four cartridges with heads filed all around, and one with head filed two-thirds around, without affecting the breech or deranging the gun in any manner.

GUNS NOT FULLY TESTED.

There were also exhibited to the Board several guns which were not subjected to the tests or accepted in competition, for reasons as respectively set forth :

THE EMPIRE BREECH-LOADER, No. 2.—This was one of the guns tested at the previous session (See page 17, Report of April 6th), and was again exhibited with an iron guard-plate bedded in the stock beneath the breech to protect the stock from destructive action of the gas and to render the breech more stable. Four 60 grain rim-fire cartridges were fired with satisfactory results, showing that one of the objections hitherto made to this arm had been removed.

HINDEN AND SCHWEIKART'S NEEDLE GUN.—Was presented by Joseph Hinden and Walter Schweikart, of Detroit, Mich. This gun, based upon the Prussian *Zundnadelgewehr*, was claimed as a great improvement upon that arm in every respect. The cartridges used with this gun were claimed as new, the explosive mixture being superior to the similar chemical compound in the Prussian cartridges, which, however, in general principles they closely resembled. The exhibitor wit-

nessed for one day the operation of other guns and then disappeared, taking away his gun and cartridges without apology or explanation.

HUBBELL'S BREECH-LOADING RIFLE.—This was one of the guns tested at the previous session of the Board (See page 21, last report). It was not subjected on this occasion to all the tests, and could not be entered into full competition, as the exhibitor was not provided with the requisite number of cartridges. In the last report, in description of this gun, it was stated that it was provided with a separate receiver, this was an error, the receiver being formed by cutting away a portion of the barrel, as in most guns of this class.

Fired one hundred 70 grain cartridges (Martin's central-fire, calibre .50, fabricated at Frankford Arsenal). There was considerable lead and residuum left in the barrel, and attributable to excessive "slugging" of the ball and inferior quality of powder. It formed a great contrast with the results from the cartridges prescribed by the Board.

Fired four cartridges (same as above) with heads filed all around; the breech not affected nor gun in any manner deranged.

The special advantage claimed for this gun is its *automatic* loading, *i. e.*, the cartridge is simply dropped into the receiver and pushed into the chamber by the act of closing the breech. The Board does not appreciate highly this point which this gun possesses in common with several others.

THE MONTSTORM BREECH-LOADER.—This also is one of the guns examined at previous session of the Board

(See page 32, Report of April 6th). The exhibitor was not prepared to enter it for competition, but presented it as a great improvement upon the former sample, in workmanship and details. It thus affords opportunity to correct the results of inadvertence in the previous report of the Board. On page 60, in giving the relative standing of guns, it was intended to place the Montstorm between "Joslyn's Cap" and "Meigs'," thus making it *fifth* in the list, but by some oversight the gun was entirely omitted from the list. As the prototype of its class (first), this gun will always be worthy of interest, and especially for merits originally ignored by successors, but now appreciated and imitated.

THE MORGANSTEIN BREECH-LOADER.—Presented by William Morganstein, Philadelphia, Pa. Two guns were exhibited, differing from that entered at previous session of the Board (See page 39, last report). Upon examination, though comprising many most ingenious contrivances, the Board did not consider them as sufficiently meritorious, in their present condition, to entitle them to competition.

THE YATES BREECH-LOADER.—This gun was exhibited to the Board, but the inventor did not enter it for competition, as it was the only sample manufactured, and he had engagements with it elsewhere. Six of Martin's central-fire cartridges, calibre .50, were used; three missed fire, and an "anvil" driven out of one of the others, deranged the action of the gun.

THE COCHRAN BREECH-LOADER.—This arm was not exhibited until the last day of the session, and consequently too late for testing.

Of the guns thus exhibited and not entered for competition, the Board is of opinion that none possess merits superior to the arms fully tested at this session.

The following general conclusions, regarding the individual guns and the several classes, are made by the Board, some of which are corrective of the conclusions made and published in the previous report :

GUNS OF THE FIRST CLASS, i. e. : With breech-block hinged to the front or rear of the receiver, and to open the breech, swinging forward in a plane, vertical or horizontal, and parallel to the axis of the barrel.

The Allin Gun.—The locking device is secure and easily manipulated. The Miller ejector is disapproved, as the forcible blow of the breech-block upon the lever, as required to eject the cartridge-case, occasions great wear by battering the lever and breech-block, and would probably, after continued use, become inefficient. This ejector was introduced to do away with a spring, which has been hitherto considered undesirable. The Board, after very careful consideration, conclude that springs of proper form, material and workmanship, will equal in endurance the other portions of the mechanism. The durability of properly manufactured and inspected springs is demonstrated by those in the lock of the Springfield muzzle-loading arms. No device can secure the exact and constant ejection of the case so well as a spring of the proper elasticity. The question of ejection of the cartridge-case is, however, one dependent upon class of breech system, and in many cases mere retraction is alone necessary.

The method of securing the breech-block hinge to the barrel, by a band entirely clasping the latter, is a most decided improvement upon the strap merely screwed on.

The Berdan Gun, No. 2.—This gun has no independent locking device for the breech, but depends upon certain nice calculations and analysis of the forces of recoil. As a merely

mechanical demonstration, such calculations may be entirely satisfactory, but applied to practice, and relying for their efficiency upon careful manufacture, and delicate adjustments involving exact measurements, they are undesirable. The best evidence of this rests in the fact that the ingenious exhibitor of this gun has presented another upon the system of absolute and separate lock.

The Berdan Gun, No. 1.—This gun exhibits the modifications induced by the tests and developments made by this Board. The “loose hinge” compensatory movement for locking the breech, is abandoned for a locking device resembling, in its general features, that of the Allin gun, and over which the majority of the Board believes that it has no material advantage. The retractor and ejector are the same as hitherto employed by Col. Berdan, and perform their several offices well and invariably.

The Lamson Gun.—This gun has no independent locking device, and the ability to close the breech and secure it when in position, depends upon a divided breech-block, the relative motion of one portion of which upon the other is equivalent in effect to the loose hinge in Berdan’s No. 2 gun. As in that arm, nice adjustments and workmanship are required, nor even then can they be considered as efficient. The guns of this system exhibited to the Board have been of beautiful workmanship and unexceptionable material, displaying great mechanical skill; yet at the previous session of the Board both the guns exhibited were disabled by the explosion of defective cartridges, and at the present session the breech of the gun, as first exhibited, was blown open by similar cartridges. It was subsequently modified, so as to withstand the test, but it is obvious that a system requiring such nice adjustments is undesirable for military arms. The retractor and ejector of this gun are highly approved by the whole Board, and its easy application to the hinge band around the barrel, or to a separate receiver, further commends it.

The Miller Gun.—The locking device of this gun is designed as an equivalent for that of the Allin, the advantages claimed being the possibility of a square recoil seat, and not crowding the cartridge case forward in opening the breech. Conceding these points, the Board does not conceive them as very material, while the sliding movement of the key and consequent friction and wear are certainly disadvantages. If to prevent wear the key is hardened, a violent explosion, as from an imperfect cartridge, may break the key, as was illustrated by the tests. The ejector of this arm has been estimated under the head of the Allin gun.

The Needham Gun.—The lateral movement of the breech-block in opening and closing the breech, is a disadvantage as a departure from the unity of movements in vertical planes, and therefore being awkward. The locking device is defective, as throwing the whole strain of resistance upon the hammer, and tending to wrench and loosen it and otherwise derange the lock. The propulsion of the firing pin by the wedging action of the prolonged hammer, is a very inferior substitute for the direct, forcible blow usually attained, and the acquired movement of the pin is very limited.

Generally of guns of this class the following conclusions are made:

1st. That the necessity of an independent locking device, as recommended in the previous report, is adhered to; the convictions of the Board on this point being strengthened by further tests and examinations.

2d. That a new, separate receiver is preferable to the formation of a receiver in the barrel itself, by cutting portions away. The breech of the gun sustains a greater shock, and therefore requires greater strength than any other part, and this can be adequately ensured only by an entirely new receiver into which the barrel is screwed or otherwise secured. Any required form or strength can thus be given to the receiver, which is really the trunk to which the whole breech mechanism is appended, while the additional weight is com-

paratively small and placed at the most advantageous point to counteract recoil. All parts can by this means be made interchangeable, and any irreparable injury to the barrel would not involve the loss of the entire arm, as another barrel could be readily substituted. The band attachment of the breech-block hinge, as in the Allin and Lamson guns, is an improvement upon the strap or saddle attachment, but the use of a new detached receiver is by far the better alternative.

3d. As in guns of this class, from the deep, trough-like nature of the receiver ejection of the discharged cartridge-case is desirable, that such ejection is best accomplished by the elastic force of a spring suddenly disengaged from tension.

4th. That as stated in the previous report, the main weakness of this class of guns consists in the unavoidable hinge attachment of the heavy breech-block, as such attachment, in view of long continued service, cannot be considered as reliably stable.

5th. That of the guns of this class, the adoption of the separate breech receiver, the Allin locking device and the Lamson ejector would represent a combination of the best details.

GUNS OF THE SECOND CLASS, i. e.: The breech-block hinged to left or right hand side of the receiver, and moving in a plane at right angles to the axis of the barrel.

No guns of this class were presented at this session. The previous conclusions of the Board regarding them are adhered to, and they are esteemed as inferior in several points to those of the first class, and which they more nearly resemble.

GUNS OF THE THIRD CLASS, i. e.: With the breech-block moving on a shoulder or pivot at its rear end, and dropping the forward end in the receiver, below the chamber, for the insertion of the cartridge.

The Roberts Gun was the only gun of this class presented at this session, and it combined many improvements since tested at the previous session. The breech-block and appendages are readily removed and replaced without dismounting the entire gun, as hitherto. A spring has also been applied to the firing-pin, retracting it when not pressed forward by the hammer. The lever should be further depressed, so as to lie closer to the neck of the stock. The strength and safety of this gun, its easy manipulation, and its capabilities for rapid firing, are conceded by the entire Board. The security of the breech-block, as against accident by premature explosion, is indubitable. The ejection of the empty cartridge-case is accomplished without springs, as the inclined position of the breech-block facilitates the ejection. Original guns on this system, while embracing all the advantages of the converted gun tested, would also be capable of other important improvements.

Generally, it may be expressed that guns of this class, from the peculiar system of the breech, are eminently safe and durable, capable of sufficient rapidity of fire; and the objection that they are not adapted to the center fire system of cartridges, is sufficiently answered by the successful tests.

GUNS OF THE FOURTH CLASS, i. e.: With the breech-block pivoted at its lower front portion, near the front of receiver and below the level of chamber, and revolving in a vertical plane, passing through the axis of the barrel, falling back to open the breech and forward to close it.

The Conroy Gun.—This arm is capable of great rapidity of fire, and the breech, when closed, is strong and safe, the locking being very efficient. The guard-lever movement is somewhat objectionable, for reasons set forth in previous report, but less so than any gun on that principle yet examined. The main and rear spring (both in one) is exposed on the under side of the gun, and on account of its importance, should be

suitably cased. There is no danger to be apprehended from premature explosion of cartridge. The mechanism of the breech is complicated, consisting of many distinct pieces, and most of them exposed when the breech is open. Possessing several good points, those of an objectionable character, combined with the great cost arising from complicated mechanism, would appear to condemn this system for alteration of muzzle-loading arms.

The Remington Gun.—The favorable opinion of this gun, as expressed in the previous report, is reaffirmed. For conversion, the same system as in an original gun is adopted. The substitution of an entirely new lock renders this alteration more expensive than many other systems. The independence of the system in its relations to the remainder of the arm and the compactness of the mechanism, are approved. The distinct receiver, as in other guns possessing it, gives an advantage in the substitution of new barrels. The brass case cartridge should be alone used in this system, as the permanent expansion of the copper cases is apt to render the opening of the breech difficult.

Generally of guns of this class it is concluded :

1st. That from the movement and attachment of the breech-block, a very strong and efficient locking arrangement is absolutely necessary for security.

2d. That ejectors are not necessary, as the simple retraction of the cartridge case disengages it sufficiently, and the form of receiver facilitates its removal.

GUNS OF THE FIFTH CLASS, i. e. : With the breech-block sliding horizontally or vertically in the receiver.

The Burton Gun was the only one of this class admitted to competition at the present session. The majority of the Board estimates it as follows : Its capability of rapidity of fire is conceded, and also its strength, the efficiency of the retractor,

and the probable low cost of alteration. Objection is made: 1st. To the sliding movement of the breech-block on account of friction and wear; 2d. To the compound motion in opening and closing the breech; 3d. To the too facile detachment of breech-block; and 4th. To the possibility of a premature explosion of the cartridge should the firing pin be jammed in a protruding position. General Ward dissents from the above objections, and esteems this gun, as a whole, superior to any other exhibited, on the score of simplicity, strength and cheapness. He considers that the loose adjustment of the breech-block, a close fit being unnecessary and indeed injurious, overcomes the first objection of his colleagues; that the compound motion is easy and practically single; and that the construction of the hammer and firing pin in one piece, and the device controlling its movement, effectually prevents any danger whatever from the last objection. Finally, that in his opinion its extreme simplicity, strength and ease of repair (there being no small pieces or screws to be lost), commend this system above all others for use in the hands of troops.

COST OF CONVERSIONS.

In accordance with paragraph II of the programme of examination, exhibitors were required to tender sealed proposals for converting the muzzle-loading arms of the State upon their respective systems, accompanied by two approved sureties in the amount of ten thousand dollars, conditioned that if the proposals were accepted before the first day of March, 1868, the guns would be converted at the rates named in the proposals. This course was adopted to secure responsible and reliable proposals. It should be remarked that exhibitors generally declared that the prices so named were estimated for the specific purpose, and not intended as published rates to govern or be taken into consideration for any other purpose, involving probably different conditions.

The sealed proposals were opened, and the following is an abstract of the same :

	PER GUN FOR CONVERSION OF			
	10,000.	20,000.	30,000.	40,000.
Allin,*.....	\$6 75	\$6 25	\$6 15	\$6 00
Berdan,†.....	6 00	5 25	5 00	4 75
Conroy,.....	10 00	9 75	9 50	9 50
Lamson,.....	5 00	4 50	4 25	4 00
Miller,.....	6 50	5 75	5 50	5 25
Remington,.....	8 00	7 50	7 50	7 00
Roberts,.....	6 00	6 00	5 75	5 50

The exhibitor of the Burton gun made an informal estimate for the respective numbers of guns, as above, at \$6.00, \$4.50, \$3.50, and \$3.50; but not furnishing any sureties, the above prices could not be considered as proposals.

No tender was made for the manufacture of conversion of guns on the Needham system.

In conclusion, after a review of the tests and a dissection and special examination of the several guns, the following resolution, *nem. con.* was adopted :

Resolved, That after careful and long continued examination and experiment, and in consideration of the combined qualities of strength, durability, safety, efficiency and economy, this Board deems the Roberts system of conversion of muzzle-loaders into breech-loaders as superior to all others examined, and recommends that the muzzle-loading arms owned by the State be converted into breech-loaders upon the Roberts system.

* An additional sum of \$2.50 for reduction of calibre by introduction of a tube into the barrel.

† The prices do not include royalties for patent rights, which were not estimated, and are inclusive of the two systems of guns exhibited.

REDUCTION OF CALIBRE.

At the close of the previous session of the Board, the conclusion (eleventh, see page 59 of previous report), was adverse to the reduction of calibre of barrel by "reinforcement." To quote "nor is the Board entirely satisfied that the processes, thus far adopted for such reduction of calibre, are such as to secure a permanent adhesion of the two tubes after prolonged service." Since that time a Committee of the Board, consisting of Colonels Baker and Burt, made a special visit to the United States Armory at Springfield, to examine this process more particularly, and received through the courtesy of Col. Benton (Ord. Dept. and Superintendent of the Armory), every facility for such purpose. Upon the favorable report of this Committee and other examinations and evidences, the Board has been led to reconsider its former decision. A gun thus reinforced, and which had been fired several thousand times, was exhibited to and fired by the Committee at Springfield, and appeared as stable and accurate as a new gun. Longitudinal and cross sections of the reinforced barrels indicate under the magnifying glass the firm union of the two parts by an interposed film of brass so thin as often to be invisible to the unaided eye. The irresistible forces of nature are well demonstrated by that capillary attraction which draws the fluid brass between two metallic surfaces forced into the closest juxtaposition, and this very tenuity proves a source of durability to the compound tube, as presenting a minimum resistance under the unequal contractions and expansion of the two metals. The Board is therefore assured of the success of the process of reinforcement, and has had occasion to confirm and strengthen its opinion as to the superiority of the reduced calibre in securing range, accuracy, and flatness of trajectory. In addition to these inherent advantages may be considered those connected with identity of calibre with that adopted for the army and navy of the United States, and which will probably govern in the armament of the militia of other States. An exceptional calibre would prove disadvantageous, not only

in its relations to that of the United States, but in its discord with future purchases of arms by the State. Special ammunition would be more costly and the adoption of improved cartridges would be rendered difficult and expensive, as the standard calibre only would be manufactured, except by special contract. The question of reduction of calibre thus becomes one of cost simply, and the conclusion of the Board is rendered as follows:

Resolved, That in the conversion to breech-loaders of the guns now owned by the State, the reduction of the calibre from .58 inch to .50 inch, by the process known as "reinforcement," is recommended; but if the increased cost occasioned thereby should endanger the probability of a speedy conversion of the guns, the Board advise delay in the reduction of the calibre, as the vast importance of an immediate adoption of the breech-loading system outweighs all other considerations based on minor details.

CARTRIDGES.

No examination of breech-loading arms would be complete and satisfactory unless comprehending a similar and careful examination of the special ammunition adapted to such arms. The superiority of the American systems of breech-loaders is based upon the use of the metallic-case cartridge, which furnishes in itself the most complete gas check yet devised, and possesses other peculiar advantages over the paper or cloth-enveloped cartridges. The Board has had neither opportunity nor suitable apparatus to make such experimental trials as they could wish, but with the limited means at its command, has given the subject as thorough an investigation as possible, and submits herewith the conclusions it has formed.

MATERIAL OF CASE.—The superiority of the brass over the copper case has been further demonstrated by the recent trials. Through the soft, *plastic* nature of the latter metal, it is forced by the explosion into every depression in the chamber, and

inclines to a permanent set which resists the retraction of the case, or, in certain systems, the opening of the breech. Brass, on account of its elasticity, is not so readily affected, and generally resumes, after the explosion, its original form and size. The proper proportions of the constituent metals in the alloy, should be determined by experiment, so as to secure the best practicable combination of elasticity and strength. In some cartridges consumed by the Board, the brass of which the cases were made contained too large a proportion of zinc, forming a brittle alloy, which occasionally cracked in the processes of forming the shell. The defects were not perceptible until revealed by the explosion. The brittleness of such an alloy also occasions cracking when the case is much smaller than the chamber, as the excessive expansion during the explosion exceeds the tenacity of the metal. By the use of brass, the taper of the case need not and should not exceed two in one hundred, and should be uniform, without abrupt contractions, either to secure increased calibre of chamber, as compared with the barrel, or for "crimping on" the ball. Such contractions in size form abrupt offsets, which interfere with the easy introduction of the case into the chamber. The crimping of the case the full length of the inserted portion of the bullet is useless and objectionable, as occasioning loss of explosive power to expand it. If the crimping process of securing the bullet is employed, it should be only at the extreme end of the case, and so as to form a perfect curve to the end of the case. Such crimping is, however, unnecessary, as by reaming out the case to a uniform size, the bullet can be made to fit so tightly that friction alone will retain it in position.

In the manufacture of cases in large quantities, constant and rigid inspection will be necessary to secure uniformity of size and shape. The constant wear of dies and stamps gradually produces a change of form and size, which, when exceeding prescribed limits, renders necessary a renewal of such portions of the machinery involving an increased cost, which contractors will naturally avoid, unless compelled by such an inspection as

involves the gauging of each case, and condemnation unless in accordance with specifications.

LOCATION AND SECURITY OF FULMINATE.—The principle of “center-fire,” as recommended in previous report, is adhered to, and further consideration has strengthened the views of the Board on this point. In addition to the advantages of this system, previously mentioned, is the greater security of the fulminate as compared with the rim-fire system. In the latter, after complete desiccation of the fulminate by long-continued storage, the violent percussion and agitation of rough transportation tends to detach the ring of fulminate, which simply adheres to the rim of the cartridge. In the center-fire cartridge, the fulminate may be secured either in the head or the anvil, so that no possible agitation would disturb it.

It has been asserted that contact with brass is injurious to the fulminate, through chemical action, though no direct evidence of such fact has been placed before the Board, but should it prove true, there is a probability that methods of preparation, either of the metallic surface or the fulminate, would be invented to obviate the difficulty. The past experience has been confined to fulminate on copper, and the use of the ordinary percussion cap for forty years has proven the permanency of such association, under all contingencies, when the fulminate has been protected from moisture. In the use of the brass case, it is not necessary that the fulminate should be placed directly upon the head of the case, in fact, it is preferably placed a slight distance from the head, to avoid explosion from ordinary percussion and requiring the strong blow of the firing-pin to explode it. It may therefore be placed in the anvil or reinforcement disc. In cartridges with percussion caps outside the case and punctured heads for the transmission of the flame, the same security is obtained. It is probable that means will be devised to hermetically secure the fulminate in some protective envelop which will insure it from deterioration by dampness or chemical agencies. In regard to external priming or location of the fulminate outside the

case, while conceding certain advantages in reloading the cases, the Board are not convinced of its advantages as compared with the internal priming. Loss of the percussion cap and leakage of gas at the cap orifice may readily result from imperfect manufacture.

POINT OF IGNITION OF POWDER.—One of the points of superiority claimed in the Prussian Needle-gun system, is the ignition of the powder at the forward end of the cartridge, by which it is represented, a more perfect and regular combustion is attained. Several cartridges have been exhibited to the Board, in which ignition was made in the center of the mass of powder and also at the forward end. The Board is not convinced that any advantages are obtained by these means over ignition at the rear end, certainly not in the experiments before the Board. With powder burning slowly, either on account of coarseness of grain or inferiority of quality, or with a large charge in a short barrel, ignition in front might be advantageous, but with seventy grains of good powder (F.), burned from the rear in a thirty-six inch barrel, the result of experiment thus far shows that all the powder is consumed in the barrel, and with a maximum useful effect. Accurate experiments as to initial velocity, penetration, &c., with different points of ignition, and using different qualities and charges of powder in barrels of different lengths, might be profitable in settling finally a question now somewhat debateable.

FORM OF CHAMBER.—The increase of calibre of the chamber in order to diminish the length of the cartridge, with calibre of barrels of .58 and .50, is condemned. To secure equal strength, the diameter of the breech must be largely increased, while the reaction of the gas against the shoulder in the chamber greatly augments the force of recoil which presses against a greater area of face in the breech-block, with consequently increased danger of derangement. A chamber more conical than hitherto indicated, i. e., with a greater contraction than two in one hundred, is, for the same reason, disadvantageous.

REINFORCEMENT OF HEAD OF CARTRIDGE-CASE.—The reinforcement of the head of the cartridge-case, by the introduction of a metallic disc or cup, is commended as practically neutralizing all danger from weak or defective heads. In spite of the greatest care in the selection of metal and the most thorough inspection of the completed cases, defective ones will occasionally pass undetected till exposed by explosion in the gun. Such defects are dangerous only in the head, as the experiments show that bursting or cracking of the sides is harmless, and it remains only to protect the head. A shallow cup of light metal, or a disc of heavier metal (serving also as an anvil), is a sufficient reinforcement, in connection with which the location of fulminate and communication of its flame to the powder are important points. As brass, from its superior stiffness, offers more resistance than copper to the blow of the firing-pin, it might be well in the manufacture of the cases, by the use of proper dies, to reduce the thickness of the head in the center, the surplus metal being distributed to advantage over the remainder of the head. The employment of the reinforcement cup or disc, by supporting the head, renders unnecessary the use of an anvil, which was difficult to secure, and served but the sole purposes of impact.

POWDER.—In the late experiments the Board prescribed the use of the Orange Rifle Powder (F G), as previous trials had proven its superior qualities, and it was desirable that all competitors should be subject to conditions as similar as possible. The results of the recent trials induce no modification of the favorable opinion of this powder as previously expressed. After firing one hundred rounds of seventy grains each, the residuum left in the barrel, and before deliquescence, weighed less than a grain, while the United States musket powder, consumed in occasional trials, fouled the barrels excessively. The Orange Rifle Powder is made from the same formula, as to proportions of ingredients, as prescribed by the United States Ordnance Department for musket powder, but the ingredients are carefully selected and the nitre more highly purified, resulting in a more perfect chemical combination in

combustion. The graining, also, is more uniform, a smaller range of sizes being allowed; the grains are dense and well glazed by attrition, no graphite being used, and resist strong grinding pressure without being crushed or soiling the fingers. The granulation, which is coarse, would appear to be perfectly adapted to a charge of seventy grains in a thirty-six inch barrel, as the powder was in all cases consumed in the barrel. The Board had no opportunity to test the relative strength of this powder, but have no reason to doubt its sufficiency in such respect, as its cleanliness and perfect combustion would indicate a high standard. The breech-loading system, combined with the metallic cartridge-case, introduces new conditions as to powder, which is now protected from mechanical deterioration by the substitution of a rigid metallic tube for the paper or cloth envelope, and is not crushed and mealed in loading. Thus secured, the best and cleanest powder is the most economical in every respect. While estimating so highly the Orange Powder, the Board disclaims any intention to depreciate that of other manufacturers, which it has had no opportunity to test.

There is a question as to the chemical stability of powder in metallic cartridge-cases long in store, and exposed to climatic extremes of heat and atmospheric moisture, which can only be determined by experience.

PROJECTILE.—Much has yet to be determined relative to the best form of projectile for breech-loading arms. Certain general principles established in regard to projectiles for muzzle-loading arms, remain applicable to breech-loaders, and in fact are capable of further development or facility of application, while many devices are rendered unnecessary. The various expedients adopted to make the bullet take the rifling in muzzle-loaders, such as the *tigè*, the culot, the Minie and other systems, are needless, and the bullet is placed in position undeformed by the ramrod. This ability to preserve the proportions and symmetry of the projectile until the moment of propulsion, by the explosion of the powder, renders the development of those points important and profitable, and

transfers attention to their preservation in the passage of the projectile through the barrel. The present bullet used in the United States breech-loaders of .50 calibre, is .52 inch in diameter in its cylindrical portion, which is two-thirds to three-quarters the entire length; the diameter of the bullet thus exceeds by .005 inch the maximum diameter of the bore measured across the grooves. This excess of diameter over calibre, called "slugging," carried to such extent, produces great friction; and in frequent and rapid firing, such leading of the barrel as not only to impair the efficiency of the arm, but endanger the person firing; nor can these evil effects be overcome by lubrication, though mitigated thereby. The leading and fouling of guns by the combined influences of great "slugging," inferior powder and inadequate lubrication, were strongly demonstrated by the tests of the Lamson and Hubbell guns at the previous trials, and of the latter arm at the present session.

The form of projectile recently introduced into the Chasse-pôt system, marks a large advance in the right direction. The general diameter is made the same as the calibre of the gun, but gradually increasing from the center to the rear, where it terminates in a band .14 inch wide, and having a diameter equal to the calibre plus twice the depth of the rifle grooves. It is found that this bullet takes the rifling well, and with a minimum of friction, while it is not spun out or deformed in its passage through the barrel. It is slightly *upset* or compressed longitudinally by the explosion, and sufficiently to prevent any windage. It has no grooves.

Two officers of the Russian Army, Col. Alex. Gorloff and Capt. Carl Hunnius, now in this country for the purpose of examining breech-loading arms, have, during the past year, made many experiments, with a view of improving the accuracy of fire with metallic-case cartridges. These gentlemen have kindly placed at the disposal of the Board a minute of their experiments. Taking as a basis the Berdan cartridge, as adapted to a .45 calibre gun, they increased the charge to eighty grains of quick-burning powder (Orange Ducking Pow-

der, No. 3) and 415 grains of lead. This large charge with a small calibre requires a brass cartridge case 2.2 inches in length. The projectile is made upon the same general principle as the Chassepôt mentioned above, except that it has four peculiarly shaped grooves around it, which not only assist in preserving the line of flight, but facilitate the upsetting or compression in firing. The mouth of the case is reamed out by machinery, so as to accurately center the projectile, which closely fits into it .2 inch, and requires no crimping to retain it in place; thus neither the case nor projectile is deformed, nor is any force wastefully expended in expanding the former to relieve the latter. With this ammunition and a gun having a barrel 36 inches in length, with a rifle twist of one revolution in twenty-four inches, depth of rifle .01 inch, and with six grooves and six lands of equal width, and a range of 156 yards "the radius of the circle drawn on the target from center of impact, so as to contain one-half of the bullets fired, is 2.2 inches, while the best muzzle-loaders, as the Swiss military gun, has this radius equal to 3.72 inches, and the Whitworth gun 5.28 inches." A very flat trajectory and high initial velocity (1,600 feet) are claimed for this cartridge. Hitherto, it would have been predicted that such a large charge of quick-burning powder, combined with rapid twist and slight increase of diameter of bullet over calibre, would inevitably produce stripping. It is to be hoped that further experiments will be made in regard to the several points involved in the results attained by Col. Gorloff.

It is at least determined by the Chassepôt experiments that the rifle revolution can be given to the projectile with less disfigurement and loss by friction than had been supposed. Col. Gorloff's experiments also determine the best method of securing the projectile in the case and centering it in the bore of the gun. Both the Chassepôt and Gorloff projectile have hemispherical heads, the paraboloid form having been abandoned at the risk of consequent increase in atmospheric resistance.

Although the great improvements in both arms and projec-

tiles have increased the range and accuracy of fire, no advance gained in the past, and applicable now, should be abandoned. Such is the constant and homogenous density of metal in the projectile attained by compression. The Board has witnessed the operation of Naylor's improved machine for compressing and grooving bullets, manufactured for the French Government by Mr. Jas. E. Grannis of this city, and was impressed by the perfection and rapidity of its action.

LUBRICATION.—In the previous report the Board laid great stress upon the proper and adequate lubrication of the barrel, and recent experiments have confirmed the opinion that it is essential in breech-loading arms. The most efficient method of accomplishing it is, however, yet to be determined, and will naturally depend upon the system of cartridge. For the actual application of the lubricant, Ball's patent machine is commended, the tallow or other substance or compound being applied to the projectile in a cold or congealed state.

CONCLUSIONS.—As regards form of case, reinforcement of head, and location and security of fulminate, the Board recommends :

For target practice, the Berdan cartridge, which can be readily reloaded, being an external primer.

For active service and general use, the Powers cartridge, which combines the principles of internal and protected fulminate, and reinforcement of the head, without use of an anvil.

TARGET PRACTICE.

The Board begs leave, before closing this report, to offer a suggestion as to the expediency of a thorough system of target practice for the National Guard. This exercise, which has gradually fallen into disuse in this country, has been revived abroad, and in England especially has served not only the direct purpose of educating the young men of the nation in

the accurate use of arms, but has stimulated martial ardor, and given to the volunteer corps, character, *esprit de corps* and a world-wide reputation. The laborious winter drills of our National Guard serve an excellent end, but the ultimate purpose of the soldier is the effective use of his weapons, and while we discipline and drill him in all the manœuvres that contemplate him solely as the fraction of a tactical whole, we should not neglect the individual instruction as a marksman, to which all other drill is merely auxiliary, and which alone renders him formidable when detached, and also acting in hostile concert with his fellows. Accuracy of fire is especially desirable in the use of breech-loading arms, as combined with rapidity of fire and long range, it gives this improved weapon the full measure of its extraordinarily destructive power. The English system would furnish the model and general details upon which could be based a system more particularly adapted to our requirements.

GEO. W. PALMER,

Com.-Gen'l Ord. S. N. Y.

W. G. WARD,

Brigadier-General.

GEO. M. BAKER,

Col. Com. 74th Regt. N. G. S. N. Y.

SILAS W. BURT,

Col. & Asst. Inspector-Gen'l.

GENERAL HEAD-QUARTERS, STATE OF NEW YORK,

ADJUTANT-GENERAL'S OFFICE, }
ALBANY, *March 27th*, 1868. }

GENERAL ORDERS, }
No. 7. }

The Board of Officers, constituted by Special Orders No. 2, series of 1867, to make an examination of breech-loading arms and report the result of said examination to these Head-Quarters, having completed their labors and rendered a final report thereof with their decision, is hereby dissolved.

The Commander-in-Chief desires to return his thanks to the members comprising the Board for the zeal, energy and indefatigableness which have prompted them in the difficult and arduous task entrusted to them, and for the desire manifested to make their examination thorough and for the greatest good to the interest and advancement of the Militia of the State.

The examinations of the Board have been attended by the representatives of several Foreign Governments, who have expressed themselves as greatly pleased with the results following the same, and who have been enabled to form a more correct judgment of the science of this class of arms; and also many improvements to our own inventors who have exhibited their skill and labor, have been suggested by the experiments made by the Board.

By order of the Commander-in-Chief.

S. E. MARVIN,
Adjutant-General.

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